federal register

WEDNESDAY, OCTOBER 8, 1975

PART II:

# DEPARTMENT OF LABOR

## Occupational Safety and Health Administration

■

# TOXIC SUBSTANCES

## Proposed Occupational Safety and Health Standards for Alkyl Benzenes, Cyclohexane, Ketones, and Ozone

## DEPARTMENT OF LABOR

### Occupational Safety and Health Administration

[ 29 CFR Part 1910 ]

[Docket No. SCP–2]

### TOXIC SUBSTANCES

### Proposed Standards for Alkyl Benzenes (p-tert-butyltoluene, cumene, ethyl benzene, alpha-methyl styrene, styrene, and vinyl toluene); cyclohexane; Ketones (camphor, mesityl oxide, and 5-methyl-3-heptanone); and Ozone

I. *Introduction.* On March 18, 1974, the Assistant Secretary of Labor for Occupational Safety and Health announced the Joint Occupational Safety and Health Administration/National Institute for Occupational Safety and Health (OSHA/NIOSH) Standards Completion Project. The purpose of the project is to issue more complete standards for all of the toxic substances listed in Tables Z–1, Z–2 and Z–3 of 29 CFR 1910.1000 (formerly Tables G–1, G–2 and G–3 of 29 CFR 1910.93), with the exception of those substances which are or will be the subject of NIOSH Criteria Documents. These substances will be covered in separate rulemaking proceedings outside of the Standards Completion Project.

II. *Background.* Section 1910.1000 now establishes permissible exposure limits for airborne concentrations of approximately 400 toxic substances. The permissible exposure limits (also referred to as eight-hour workshift time weighted averages (TWA)) listed in § 1910.1000 are not at issue in this proceeding, and no changes to these limits will be proposed or made in the standards issued as part of the Standards Completion Project.

OSHA proposes to amend Part 1910 of Title 29 of the Code of Federal Regulations by the addition of provisions for eleven toxic substances: p-tert-butyltoluene, cumene, ethyl benzene, alpha-methyl styrene, styrene, vinyl toluene, cyclohexane, camphor, mesityl oxide, 5-methyl-3-heptanone, and ozone. The proposed standards, if adopted, will establish requirements for measurement of employee exposure, medical surveillance, methods of compliance, handling and use of liquid, solid, gas or vapor forms of the substances, employee training, recordkeeping, and sanitation, among other things.

In addition, the proposals are designed to enable employers to better understand and comply with existing OSHA safety and health standards that relate to the above listed substances. For example, the proposed standards attempt to compile in a single place, by the use of cross references, requirements appearing elsewhere in Part 1910 which are likely to be of particular importance where any of the above listed substances are present or are used in the workplace. Some of the referenced standards which would apply to the use of the substances covered in this proposal require the employer to classify a substance by its physical properties. For example, § 1910.106 prescribes storage requirements for combustible and flammable liquids, defined in terms of flash points and boiling points. Unless the employer knows what the flash point and boiling point of a liquid in his establishment is, he cannot classify it and will not know how to store it. This proposal will inform employers of the proper classifications of these substances in the context of such existing requirement.

III. *Toxic substances.* The proposed standards apply to the following toxic substances:

*p-tert-Butyltoluene* (Common synonyms: 1-(1,1-dimethylethyl)-4-methylbenzene, 1-methyl-4-tert-butyl-benzene, p-methyl-tert-butyl-benzene, TBT), Chemical Abstracts Service (CAS) Registry Number 98–51–1, is a clear, colorless, combustible liquid, with a distinct, aromatic odor. It is produced by the alkylation of toluene with isobutylene. p-tert-Butyltoluene is used as a solvent in the preparation of resins and as a primary intermediate for synthesis in the chemical and pharmaceutical industries.

The primary toxic effect of p-tert-butyltoluene is irritation of the skin and respiratory tract. Absorbed p-tert-butyltoluene may depress the central nervous system and the bone marrow. Decreased blood pressure, increased pulse rate and abnormal response to tests of cardiovascular stress have also been reported in employees exposed to the substance.

*Cumene* (Common synonyms: 1-methylethyl-benzene, isopropylbenzene, 2-phenylpropane, cumol), CAS Registry Number 98–82–8, is a clear, colorless, combustible liquid with a sharp, aromatic odor. It is produced by the alkylation of benzene with propylene and by fractionation of petroleum distillates. Nearly all of the cumene produced is used as raw material for phenol and acetone. It is also used as a thinner for paints and enamels and as a constituent of certain petroleum-based solvents. The production of cumene in 1974 was 2.92 billion pounds.

Exposure to cumene may cause irritation of the eyes, skin and upper respiratory tract. At sustained high levels of exposure, narcosis leading to coma may occur.

*Ethyl benezene* (Common synonyms: phenyl ethane, ethyl benzol), CAS Registry Number 100–42–5, is a clear, colorless, flammable liquid. It has an aromatic odor. Almost all ethyl benzene is produced by the alkylation of benzene with ethylene, although a small amount is isolated from mixed xylene streams. Most ethyl benzene is used in the synthesis of styrene; it is also used as a constituent of motor and aviation fuels and commercial aromatic solvents for paints and lacquers. Ethyl benzene production in 1974 was 5.7 billion pounds.

Ethyl benzene is an irritant to the eyes and mucous membranes of the upper respiratory tract. Exposure to the substance may produce headache, and at sustained high levels of exposure, narcosis leading to coma may occur. Skin contact with ethyl benzene may produce a dermatitis.

*alpha-Methyl styrene* (Common synonyms: 1-methylethenyl-benzene, AMS, isopropenyl benzene) CAS Registry Number 98–83–9, is a colorless, combustible liquid with a characteristic odor. It is produced commercially by the dehydrogenation of cumene and also as a byproduct in the manufacture of phenol and acetone by the cumene oxidation process. It is used as a starting material for the synthesis of chemicals and drugs and is also polymerized to form plastics and acid resins. The production of alpha-methyl styrene in 1973 was 52.5 million pounds.

Exposure to alpha-methyl styrene may cause irritation of the eyes, upper respiratory tract and skin. Prolonged and repeated exposure may result in central nervous system depression. Prolonged contact with the skin may produce a dermatitis.

*Styrene* (Common Synonyms: Ethenyl benzene, phenylethylene, vinyl benzene, styrene monomer, styrol, styrolene, cinnamene, cinnamenol, cinnamol), CAS Registry Number 100–42–5, is a clear, colorless, flammable liquid. It has a sweet, pleasant odor at low concentrations, but a disagreeable odor at higher concentrations. Chemically, it is highly reactive. Inhibitors must be added to it during storage to prevent spontaneous polymerization.

Styrene is produced commercially by the catalytic dehydrogenation of ethyl benzene and by the demethylation of cumene. It has become important industrially in the manufacturing of plastics and synthetic rubber. Styrene is used as a modifying additive for resins and as a chemical intermediate. Its production in 1974 was 6 billion pounds.

Styrene may be inhaled or absorbed through the skin. It can cause irritation of the eyes and upper respiratory tract. Styrene is a defatting agent and exposure to the liquid may produce cracking and inflammation of the skin. Exposure to high concentrations of the substance may cause central nervous system depression.

*Vinyl toluene* (Common Synonyms: 1-ethenyl - 4 - methyl - benzene, methyl styrene, tolyl ethylene, mixed isomers of meta- and para-vinyl toluene) CAS Registry Number 622–97–9, is a colorless liquid with a disagreeable odor. A combustible liquid, vinyl toluene is a mixture of meta- and para-vinyl toluenes that are produced by dehydrogenation of the meta- and para-ethyl toluenes. The meta- and para-ethyl toluenes are in turn obtained by reacting toluene with ethylene. Vinyl toluene is used chiefly in the manufacture of unsaturated polyester resins.

Exposure to vinyl toluene may cause irritation of the eyes, upper respiratory tract and skin. Exposures to high concentrations for prolonged periods may produce central nervous system depression.

*Cyclohexane* (Common synonyms: hexahydrobenzene, hexamethylene, benzene hexahydride), CAS Registry Number 118–82–7, is a colorless, flammable liquid with a mild, sweet odor. It is manufactured by the catalytic hydro-

genation of benzene and by distillation from petroleum. Cyclohexane's most important use in as a chemical intermediate in the synthesis of adipic acid (used in the manufacture of nylon-6,6 and engineering plastics), and caprolactam (used in nylon-6 production). Cyclohexane is a solvent for resins (used in wire coating), cellulose ethers, fats, waxes, essential oils (used in the perfume industry), and crude rubber. In 1974, cyclohexane production was 2.34 billion pounds.

Cyclohexane is irritating to the eyes and respiratory tract. Prolonged or repeated contact may cause defatting of the skin, resulting in dermatitis. High exposures may result in central nervous system depression and may cause dizziness, nausea and unconsciouness.

*Camphor* (Common synonyms: 1,7,7-trimethyl-2-oxobicyclo(2,2,4) heptane, 2-camphonone, synthetic camphor, gum camphor, laurel camphor), CAS Registry Number 464–49–3, is a white, transparent, crystalline mass with a characteristic odor. It sublimes readily at normal temperatures. Camphor is a bicyclic, saturate terpene ketone.

More than three-fourths of the camphor sold in the U.S. is produced synthetically from pinene. Camphor is also obtained as a natural product from wood distillation.

It is used as a plasticizer in the manufacture of plastics, as a preservative in pharmaceuticals and cosmetics, and as insect repellent (particularly against clothes moths). Camphor is also used in lacquers and varnishes, explosives, pyrotechnics, embalming fluids, foods and tobacco products, and in the manufacture of cymene.

Camphor is primarily a local irritant. Exposure to camphor may produce irritation of the eyes and nose, with a risk of loss of the sense of smell. High exposures affect the central nervous system, resulting in nausea, vomiting, dizziness, agitation and convulsions.

*Mesityl oxide* (Common synonyms: 4-methyl-3-penten-2-one, isobutenyl methyl ketone, methyl isobutenyl ketone, isopropylidene acetone), CAS Registry Number 141–79–7, is an oily, colorless or clear pale yellow, flammable liquid. It has a strong, peppermint-like odor. Mesityl oxide is made by dehydration of diacetone alcohol using a trace of iodine as a catalyst. It is used as a solvent for cellulosic materials, vinyl chloride, high molecular weight copolymer resins, stains and roll-coating inks. It is also used in the lacquer and leather industries, and has found utility in ore flotation and in the manufacture of methyl isobutyl carbinol.

Mesityl oxide is irritating to the eyes and mucous membranes, and is narcotic at high concentrations. Liquid mesityl oxide produces marked irritation and corneal injury upon contact with the eye. Skin contact with liquid mesityl oxide may result in irritation. Kidney damage and chronic central nervous system effects have been reported in experimental animals exposed to mesityl oxide.

*5-methyl-3-heptanone* CAS Registry Number 541–85–8, is a colorless, combustible liquid with a mild, fruit odor. (In table Z–1 § 1010.1000 this substance has been inaccurately designated as ethyl sec-amyl ketone. The more precise name for the substance is 5-methyl-3-heptanone. It is also inaccurately referred to as ethyl amyl ketone, EAK and amyl ethyl ketone). It is derived primarily from french lavender oil by isolation and purification, but it is also produced synthetically. 5-methyl-3-heptanone is used as a solvent in various operations such as surface coating, silk screen printing and rubber-making. It is also used as a chemical intermediate.

The substance is moderately irritating to the eyes and mucous membranes. At high concentrations central nervous system depression may occur, leading to narcosis and eventually coma. Skin contact with the liquid may result in dermatitis due to the chemical's action as a defatting agent.

*Ozone* CAS Registry Number 10028–15–6 is an unstable, corrosive and highly reactive gas with a colorless to blue color and a pungent, characteristic odor. Ozone is formed photochemically in the earth's stratosphere, and produced commercially from air or oxygen by a form of electric discharge. Usually all ozone is generated at the point of use. However, a small amount of ozone bottled in cylinders may be available. Ozone may also be produced unintentionally by operations involving high intensity ultraviolet light (such as hot metal operations, plasma torch operations, direct copying machines, etc.) and high voltage electrical equipment (such as electrostatic precipitators, corona discharge, arc welding, etc.). Ozone is used as an oxidizing agent in the purification of drinking water, preparation of chemicals, treatment of industrial wastes, deodorization of air and sewage gases, and control of bacteria in food in cold storage.

Ozone is extremely irritating to the upper and lower respiratory tract. It may produce local irritation of the eyes and mucous membranes. Ozone may cause pulmonary edema at high exposures. Systemically, ozone has been reported to mimic the effects of ionizing radiation, and thus may damage chromosomal structures.

IV. *The proposal.* OSHA proposes to amend Part 1910 by the addition of standards for p-tert-butyltoluene, cumene, ethyl benzene, alpha-methyl styrene, styrene, vinyl toluene, cyclohexane, camphor, mesityl oxide, 5-methyl-3-heptanone, and ozone. The proposal includes the following major provisions.

*Permissible exposure limit.* The proposal defines permissible exposure by reference to the exposure limits listed in Tables Z–1 and Z–2 of § 1910.1000. As previously stated, the permissible exposure limits have not been changed and are not at issue in this proceeding.

*Action level.* The proposal sets the action level as one half the eight hour time weighted average exposure. The action level is the point at which certain provisions of the proposed standards must be initiated, such as employee exposure measurement, training of employees and medical surveillance.

OSHA believes it is appropriate to designate one half of the permissible time weighted average exposure, as the action level, for the following reasons.

Two kinds of uncertainties can infect an employer's efforts to be reasonably confident of the results of his exposure measuring program. First, he must know if his sampling and analysis accurately informs him of his employee's actual exposure level on the day of measurement. Assuming that an employee's exposure has been properly measured (excluding such things as precision and accuracy of the sampling method) an employer can be reasonably sure of the employee's exposure on the day of measurement.

Second, the employer must also know whether the measured exposure level on one day is indicative of exposure levels on days he does not measure. It is known that the level of contamination in occupational environments varies from day to day in a random fashion. This variation in levels is unavoidable; is only minimally connected to the precision and accuracy of the method of measurement, and does not include variations due to changes in work processes or controls.

OSHA has statistically determined that at any measurement exposure level below the permissible limit, some possibility exists that on unmeasured days the employee may be exposed over the permissible limit. (Leidel, N.A., Busch, K.A. *et al.*, "Exposure Measurement Action Level and Occupational Environmental Variability, "DHEW, PHS, CDC, NIOSH, DLCD (August 1975).) Above one half the permissible limit, i.e. the action level, the statistical risk is such than an employer cannot reasonably be confident that his employees may not be overexposed. Therefore, requiring exposure measurements to begin at the action level provides the employer with a reasonable degree of confidence in the results of his measurement program.

In view of these considerations and in order to provide maximum employee protection, the proposal would also require the employer to commence medical surveillance and employee training programs at the action level.

*Exposure measurement.* In establishments where any of the regulated substances are released into the workplace air, the employer is required to make a written initial determination, which is an estimate of whether any employee may be exposed to concentrations in excess of the action level. This written determination must be made even if the results are negative; that is, even if the employer determines that no employee is exposed above the action level. This initial determination is normally a simple calculation of exposure based on the amount of the regulated substance present in the workplace, the size of the workplace, the type of operation being performed, the amount and type of ventilation, and the proximity of employees

to the substance emission source. The proposal does not require the employer to measure or sample airborne concentrations when performing this initial determination, but if any measurements are taken or have been taken they must be considered in making the determination. The employer must be certain that the initial determination accurately reflects employee exposure conditions over the working day.

It must also include any information or observations that indicate the level of exposure. Such information should include: employee complaints of signs or symptoms that may be attributed to overexposure; reports from OSHA or NIOSH based on the results of surveys or inspections; results of a survey performed by a professional industrial hygienist; and relevant information from insurance companies, trade associations, and suppliers.

In establishments having, more than one work situation involving a regulated substance, a written determination must be made for each such situation. For example, in a plant where a regulated substance is used in both dip tank and spray finishing operations, a determination must be made for each operation. A new determination is required each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of the regulated substance.

When any exposure determination indicates that an employee may be exposed in excess of the action level, the employer must measure the exposure of the employee most likely to have the highest exposure. If the results of this measurement indicate that this employee is exposed to concentrations in excess of the action level, the employer must measure the exposures of all employees similarly exposed to the substance. If exposure measurements show that an employee is exposed to concentrations at or above the action level, but below the permissible exposure limit, measurements of that employee's exposure must be made every two months. If they show an employee exposed to concentrations above the permissible limit, the employer must measure the employee's exposure at least monthly, inform the employee of his over-exposure, and take steps to reduce the employee's exposure. The measurement program may be terminated for any employee if the results of two consecutive measurements, taken at least one week apart, show he is not exposed at or above the action level.

The measurement provisions are designed in this step-by-step fashion so that employers having workplaces where only low concentrations of toxic substances are present will not be required to measure the exposure of each individual employee. The intent of this procedure is to provide adequate protection for employees while minimizing the administrative and financial burden on employers.

Bimonthly measurement for employees whose exposures range between the action level and permissible level is intended to assure that the permissible exposure is not exceeded and to provide sufficient warning when exposures are approaching the permissible limit. Data from fewer samples would not provide statistical information of an accuracy necessary to assure protection of employees.

Where employee exposures are above the permissible limit, monthly measurements would be required since OSHA believes that exposure above the permissible limit presents a hazard to the employee and, therefore, all parties should be aware of continued overexposure and continuing efforts to reduce such exposures. Monthly measurements would be required even when employees routinely wear respirators, because the type of respirator to be worn is determined by the airborne concentration of the regulated substance.

The proposal provides for the termination of exposure measurement when the results of two samples indicate levels below the action level. Requiring two samples to terminate the measurement program would preclude termination of measurement based on measuring an unrepresentative day. A requirement for at least a period of one week between samples has been included to ensure that any recorded decrease in exposure levels is not merely a short-term reduction in exposure resulting from temporary process or weather changes. This would not preclude an employer from using a second sample taken more than a week after the first for this purpose. It should be noted that the termination of measurement requirements would be effective only as long as there is no change in production, process, or control which could result in new or increased exposure. If such a change occurs, the procedure, beginning with the initial written determination, must be repeated.

*Methods of measurement.* The provisions of the proposed standards regarding methods of measurement of employee exposure are designed to assure that employee exposures are measured according to methods that will produce relatively accurate results. While relative accuracy is required, the employer is given latitude in choosing the equipment or method which best accommodates his financial and personnel resources. Moreover, the employer is not requried to use a specific measurement method, but rather can use any method meeting specified accuracy requirements. There are no specifications in the proposed standards concerning the duration or number of samples which must be taken to determine individual employee exposures. Any appropriate combination of long-term or short-term samples would be acceptable so long as the combination and duration of samples is an adequate basis on which to calculate the eight hour average exposure.

It is recommended in Appendix B that the eight hour average exposure be calculated from a single sample, two 4-hour samples or from a series of short-term samples (up to 30 minutes). These requirements allow the use of relatively inexpensive measurement methods, such as gas detector tubes. The employer should select the method which best fits his particular situation. Appendix B is intended to be an information source for the employer and is provided to aid the employer in meeting the requirements of the standards.

The accuracy of the sampling method must be at a confidence level of 95 percent. The proposal sets accuracy parameters for measurements. "Accuracy" refers to the difference between a measured value and the true concentration present in the air. It allows for both the random variation of the measurement method (its precision), and the difference between the average result from the method and the true value (bias of the method). For example, the required accuracy for concentrations of the regulated substances above the permissible exposure limit is 25 percent at a 95 percent confidence level. This means that out of a long series of measurements, 95 percent must be within 25 percent of the true value.

*Methods of compliance.* The proposed standard requires that engineering or work practice controls shall be used to reduce exposure to the regulated substances to at or below the permissible exposure limit. However, in situations where engineering and work practice controls are not sufficient to reduce exposures to the permissible limit, they shall nonetheless be used to reduce exposures to the lowest level feasible, and shall be supplemented by the use of respirators.

OSHA feels that the compliance priorities are in keeping with good industrial hygiene practices. Engineering controls are preferred because they reduce airborne concentrations of the toxic substances at the source of emission, and are not highly subject to human error. Work practice controls, such as good housekeeping, which reduce spills and other sources of emissions, and actions, taken by employees to stay out of high concentration areas when their work does not require them to be there, are only as good as the supervision provided. Also, failures of work practice controls are not generally as easily detected and controlled as are failures of engineering controls. However, although work practice controls may not be as reliable as engineering controls in reducing employee exposure, they share a preferred position with engineering controls as acceptable methods of compliance.

OSHA welcomes public comment as to whether engineering controls should be the sole/preferred method of compliance and work practice controls permitted only when engineering controls are not feasible.

When mechanical ventilation is used as an engineering control, the proposed standard requires that the system be tested at least every three months to ensure proper functioning. Massive failures should provide adequate warning. The periodic, simple measurements required are designed to detect gradual decreases in ventilation effectiveness, which might otherwise go unnoticed.

Changes in production, process, or control require retesting of the ventilation system to assure the continuing effectiveness of the system under changed conditions.

*Respiratory protection.* Respirators are the least satisfactory means of exposure control because they are capable of providing good protection only if they are properly selected, properly fitted, worn correctly by the employees, and if they are replaced when they cease to provide adequate protection. While it is possible for all of these conditions to be met, it is more often the case that they are not, and as a consequence, the protection of employees by respirators is not effective. Further, employees with impaired respiratory function may not be able to wear certain types of respirators, such as those operating in the negative pressure mode.

Despite the inherent difficulties associated with respirator use, they remain the only form of protection when engineering and work practice controls are not feasible or are inadequate. The proposed standards allow respirators to be used to control employee exposure in certain other specific situations, such as for very short periods (not more than one hour per day, one day per week) or in emergencies.

The proposed standards require employers to select NIOSH-MESA approved respirators. Acceptable respirators prescribed by these proposals were selected by OSHA on the basis of such relevant items as the substances' warning and irritation properties and respirator protection factors, i.e., measures of facepiece leakage. Table 2 lists the respirators acceptable at various airborne concentrations or conditions. However, the employer may always select a respirator providing greater protection; that is, one prescribed in Table 2 for higher concentrations of the substance than are present in the workplace.

*Fire and safety.* As previously stated, the proposed standards cross reference various sections of 29 CFR Part 1910 applicable to the regulated substances for the purpose of aiding employers in compliance. This is particularly true of the proposed sections on fire and safety.

The proposed standards would require the employer to familiarize himself with the guidelines for the safe handling and use of each regulated substance present in his establishment. These guidelines are found in Appendix B to each of the proposed standards. The guidelines give chemical and physical data for each regulated substance, information on fire and explosion hazards, and spill, leak and disposal procedures. Together with the references given in the fire and safety section of the standard, Appendix B provides a basic reference of the known safety and health hazards of each regulated substance.

*Personal protective clothing and sanitation.* The proposed standards contain requirements for the use of protective clothing and equipment and for actions to be taken when a liquid or solid form of a regulated substance comes into contact with either the employee's clothing or skin. The toxic properties and the fire hazards posed by each regulated substance were considered in these requirements. To ensure uniform interpretation and enforcement of the personal protection and sanitation requirements for substances of similar toxic and hazardous properties, OSHA and NIOSH have developed requirements stated in standardized words and phrases, based, in essence, on the type and duration of effect and amount and physical state of the substance.

Some of these words and phrases are designed to have precisely distinguishable meanings. For example, requiring employees to "immediately" remove clothing when it becomes "wet" with a substance, should be distinguished from requiring removal "promptly" when clothing becomes "contaminated" with a substance.

The "immediate" removal of clothes requires the employee to strip in place. "Prompt" removal of clothes allows action to be delayed only as long as necessary for the employee to get to a change room, lavatory or similar facility. The proposal would require "immediate" action for substances known to have the potential for causing serious injury if not immediately attended to, or which present an immediate fire hazard. "Contaminated" applies to any amount of the substance, however small, for which there is either visual or sensual evidence of contact. Included would be clothing soiled with a solid substance or splashed with a few drops of a liquid. "Wet" applies to an amount of a liquid which covers or permeates a section of an employee's skin or clothing in such an amount that the substance would not evaporate before post-exposure control requirements (e.g., removal of the clothing or washing of the affected parts of the body) could be complied with.

*Spills and disposal.* When applicable, the proposed standards contain procedures for the cleanup and disposal of spills of the regulated substances. The purpose of these procedures is to prevent fires, explosions, or dispersion of the substances into the workplace in such a manner as to cause the permissible exposure limit to be exceeded. These procedures are established as general duties since it is not possible to specify precisely how a spill will be cleaned up in a particular situation. Therefore, for chemicals with flash points of less than 60 C. (140 F.), the standards merely require immediate elimination of the sources of ignition, and prohibit flushing of the substances into confined spaces such as sewers or drainage systems.

*Training and information.* Whenever the regulated chemicals are present, the employer is required to have copies of these regulations with Appendixes A, B, and C present in the workplace and make them available to employees. This requirement merely assures that those who wish to do so can readily obtain information concerning possible hazards in their work environment.

The proposal would require the employer to provide an annual training program for employees exposed to a regulated substance in excess of the action level, employees exposed to skin contact with a liquid (or solid, when applicable) form of a regulated substance, and employees who work where the regulated substances present a fire or explosion hazard. This employee training program must, at a minimum, present the information contained in the Substance Safety Data Sheet (Appendix A); a review of the signs and symptoms of exposure, and medical conditions which may be aggravated by exposure to the regulated materials; and instruct employees to report any such signs, symptoms or medical conditions to the employer. Employees must also be trained in the safe use of the regulated substances, emergency procedures, and correct use of protective equipment. This training will contribute to employee safety and health by providing information which will enable employees to protect themselves from hazards which may be encountered in working with these toxic substances.

*Medical surveillance.* This proposal prescribes different medical programs depending on the substance to which employees are or will be exposed.

*Ozone and p-tert-Butyltoluene.* For employees who will be exposed to airborne concentrations at or above the action level of p-tert-butyltoluene and ozone, preplacement and periodic medical examinations at designated intervals are required. Preplacement and periodic medical examinations are also required for those employees who will be exposed to skin contact with liquid p-tert-butyltoluene. Moreover, interim examinations are required if the employee develops certain signs or symptoms and suspects they are caused by exposure to the substance. The scope of these interim examinations will vary, in the judgment of the examining physician, in light of the signs or symptoms prescribed.

*The other regulated substances.* The proposal requires the employer to obtain a limited medical history from all employees who are, or who will be, subject to skin contact with liquid forms of the substances or will be exposed to airborne concentrations at or above the action level. Preplacement surveillance is limited to the taking of a medical history to disclose employees with specified pre-existing conditions which might put them at increased risk from exposure.

Replacement medical examinations are required only if an employee indicates a history of certain conditions which may place him at increased risk. Medical examinations must also be made available to any employee who reports that he has developed any of the specified medical conditions, or that he has developed any of the signs or symptoms of exposure listed in the Substance Safety Data Sheet in Appendix A of each proposal. These examinations will also vary in scope, in the judgment of the examining physician, in light of the signs or symptoms prescribed.

When a medical examination is required, the employer must provide the

examining physician with a copy of these standards, a description of the employee's duties as they relate to his exposure, so that the physician will understand the circumstances which lead to exposure to a regulated substance; a description of any personal protective equipment used by the employee, including respirators; and information concerning actual and estimated exposures to which the employee has been or will be exposed. If requested by the physician, the employer must also provide any available employee medical history information. This provision will assure that the physician has enough information readily available so that he may provide an opinion based on all of the relevant facts. Appendix C is provided to aid the physician in evaluating the potential health hazards.

Following the medical examination, the employer must obtain a written opinion from the examining physician stating whether the employee has any medical condition that would place him at increased risk to his health, or that would be aggravated by exposure to one of the regulated substances. The written opinion must also state any recommended limitations on the employee's exposure to the substances and any limitations upon the employee's ability to wear respirators or other protective equipment. Further, the opinion must state that the employee has been informed of any medical conditions which would require further examination or treatment. However, the written opinion shall not contain specific findings or diagnoses unrelated to the employee's exposure to any of the regulated substances encountered in the workplace. The proposal also provides that no employee shall be exposed to a regulated substance in such a way as to put the employee at increased risk of material impairment of his health from such exposure.

*Recordkeeping.* The proposal requires the employer to maintain written records of the following: exposure determinations, measurements of employee exposure, tests of mechanical ventilation systems (where such systems constitute engineering controls), annual training sessions, and records required by employee medical surveillance provisions.

OSHA is aware that certain provisions of this proposal, such as medical surveillance and the extended retention period for medical monitoring records, may pose special problems to some employers, especially those who have small numbers of employees, operate with non-fixed places of employment, or use workforces which are highly transient in nature.

This awareness has been expressed by the Department of Labor in a statement submitted to the House Subcommittee on Environmental Problems Affecting Small Business on 26 June 1975, as follows: "It has become increasingly evident that the combined body of Federal regulations imposes a substantial, and, to some extent, unnecessary burden upon employers, particularly those who run small businesses. While most of these requirements serve a necessary and useful purpose, a definite potential exists for duplication, conflicting standards, and inappropriate recordkeeping requirements. In an effort to eliminate problems where any exist in the Department of Labor, I have requested my agency heads to assess the small business impact of the laws they administer and determine what can be done to ease the burden on the small employer, while still assuring compliance with the law."

Although it is clear that OSHA's first and prime responsibility is to assure employee safe and healthful places of employment, the Act and its legislative history recognize that economic and technological feasibility are legitimate factors to be considered in the setting of occupational safety and health standards.

In addition, the Act explicitly takes cognizance of its impact upon affected small business, specifically with respect to any recordkeeping requirements which are imposed.

Pursuant to section 8(d) of the Act, OSHA is exploring methods of reducing, to the maximum extent possible, the administrative and economic burdens of the proposal's various recordkeeping requirements.

While the proposal does not address itself to specific alternatives, OSHA invites comments concerning options which would both provide full protection to affected employees and at the same time would minimize the administrative and economic burden on affected employers—especially those with small numbers of employees, non-fixed workplaces, or highly transient workforces.

*Access to records.* The proposals provide for access to records of exposure measurements by employees, former employees or their representatives, and access to medical records by physicians designated by employees or former employees. It should be noted, however, that the employer is required to maintain records only for the period of time specified in the proposals. Therefore, although a former employee has the right to have his medical records made available to his private physician, this right only exists as long as the employer retains such records after the person leaves his employ.

*Observation of measurement.* Section 8(c)(3) of the Act provides that where measuring of employee exposure to a toxic substance is required by a standard, the Secretary shall, by regulation, ensure that employees or their representatives have an opportunity to serve such monitoring.

Accordingly, the proposed standards would require employers to give affected employees or their representatives an opportunity to observe any measuring of employee exposure to any of the regulated substances conducted pursuant to these regulations. The proposals require the observers to use whatever personal protective devices are required, and to comply with all other applicable safety procedures.

In order to effectively exercise the opportunity, observers would be entitled to receive an explanation of the measurement procedure, observe all the steps related to the measurement procedure that are performed at the place of exposure, and to record the results obtained.

*Appendixes.* The information contained in the three appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed by the standard or to detract from any existing obligation. Appendix A, the "Substance Safety Data Sheet," is geared to the employee. It explains, in simple language, the substance identification, health hazards associated with the regulated substance, emergency first aid procedures, protective clothing and equipment to be used in working with the regulated substance, and precautions for the safe use, handling, and storage of the regulated substance.

Appendix B, the "Substance Technical Guidelines," is meant to aid the employer in complying with the requirements of the proposed standards. It includes physical and chemical data, fire and explosion hazard data, details of cleanup and disposal of spills, and information on how to take air samples.

Appendix C, the "Medical Surveillance Guidelines," is intended for the examining physician. The employer is required to provide it to the physician when employees are undergoing required medical examinations. Because a physician cannot be expected to be knowledgeable about all of the chemical substances used in industry, and in many instances the usual medical libraries lack the necessary information, Appendix C assures that the physician has adequate information to conduct a meaningful examination.

As stated in 29 CFR 1910.5, specific rules prevail over more general ones. It should be noted that these proposals, if adopted, will supersede § 1910.134(c) and (g) § 1910.93(e), and § 1910.133(a)(1) as they relate to these substances, and any other provision of Part 1910 which is not consistent with the provisions contained herein.

*Public participation.* Interested persons are invited to comment on the proposed standards. Written data, views, and arguments concerning the proposals must be submitted in quadruplicate to the Docket Officer, Docket SCP–2, Occupational Safety and Health Administration, Room N3620, 200 Constitution Avenue, N.W., Washington, D.C. 20210, on or before December 1, 1975. Written submissions must clearly identify the provisions of the proposal addressed and the position taken with respect to each such provision. The data, views, and arguments will be available for public inspection and copying at the above address. All written submissions received will be made a part of the record of this proceeding.

In addition to the comments and objections invited above, OSHA hereby solicits comments from interested persons regarding the potential inflationary impact of each of the proposed standards. Comments may be directed toward any or all of the following subjects:

(1) Cost impact on consumers, businesses, markets or Federal, state, or local government;

(2) Effect on productivity of wage-earners, business or government;

(3) Effect on competition;

(4) Effect on supplies of important materials, products, or services;

(5) Effect on employment; and

(6) Effect on energy supply or demand.

It is OSHA's intention to prepare an inflationary impact statement and analysis, if appropriate, or a certification that the proposals have no substantial inflationary impact, at least 30 days prior to any public hearings on the proposed standards. The potential inflationary impact of each of the proposed standards will be an appropriate issue at the hearings.

This procedure has been concurred in by the Council on Wage and Price Stability in accordance with the Office of Management and Budget Circular A-107 (January 28, 1975), issued pursuant to Executive Order 11821 (39 FR 41501, November 27, 1974).

Comments and information relevant to the possible environmental impact of the Standards Completion Project, of which this proposal is a part, are also solicited. The National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321–4347), requires, among other things, that Federal agencies assess their proposed major actions, including rulemaking, to determine whether a significant impact on the quality of the human environment may result. OSHA has prepared a draft environmental impact statement on the project.

On August 29, 1975, the Council on Environmental Quality published a notice of the availability of a Draft Environmental Impact Statement on the Standards Completion Project in the Federal Register (40 FR 39923–39926). The Draft EIS is available in the OSHA Technical Data Center, Room N3620, Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210. Any interested person may obtain a copy of the draft EIS by addressing a request to the above address.

Accordingly, pursuant to Sections 6(b) and 8(c)(3) of the Occupational Safety and Health Act of 1970 (84 Stat. 1593, 1599; 29 U.S.C. 655, 657), and 29 CFR Part 1911, it is hereby proposed to amend Subpart Z of Part 1910 of Title 29, Code of Federal Regulations by adding eleven new sections as set forth below.

Sec.

| | |
|---|---|
| 1910.1032 | p-tert-Butyltoluene. |
| 1910.1033 | Cumene. |
| 1910.1034 | Ethyl benzene. |
| 1910.1035 | alpha-Methyl-styrene. |
| 1910.1036 | Styrene. |
| 1910.1037 | Vinyl toluene. |
| 1910.1038 | Cyclohexane. |
| 1910.1039 | Camphor. |
| 1910.1040 | Mesityl oxide. |
| 1910.1041 | 5-Methyl-3-heptanone. |
| 1910.1042 | Ozone. |

Signed at Washington, D.C. this 29th day of September 1975.

JOHN T. DUNLOP,
*Secretary of Labor.*

## § 1910.1032 p-tert-Butyltoluene.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of p-tert-butyltoluene, not in excess of 10 parts per million (ppm) (60 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for p-tert-butyltoluene.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which p-tert-butyltoluene is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of p-tert-butyltoluene at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of p-tert-butyltoluene.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to p-tert-butyltoluene;

(ii) Any measurements of p-tert-butyltoluene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to p-tert-butyltoluene; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to p-tert-butyltoluene at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to p-tert-butyltoluene at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to p-tert-butyltoluene at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to p-tert-butyltoluene above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to p-tert-butltoluene above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to p-tert-butyltoluene below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| *Concentration* | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to p-tert-butyltoluene above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of p-tert-butyltoluene shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of p-tert-butyltoluene.

(ii) Where a fan is located in ductwork and where p-tert-butyltoluene is present in the ductwork in concentrations greater than 3500 ppm, the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance be-

tween the fan rotating element and the fan casing so as to prevent contact.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of p-tert-butyltoluene to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for p-tert-Butyltoluene*

| *Condition or vapor concentration* | *Respiratory protection* |
|---|---|
| 500 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge(s). |
| | Gas mask with chin-style or front- or back-mounted organic vapor canister. |
| | Supplied-air respirator with a full facepiece, hood, or helmet. |
| | Self-contained breathing apparatus with a full facepiece. |
| 1,000 p/m or less | A type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, hood, or helmet operated in continuous flow mode. |
| Greater than 1,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| | A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors. |
| | Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for p-tert-butyltoluene.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of p-tert-butyltoluene shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, p-tert-butyltoluene is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of p-tert-butyltoluene shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid p-tert-butyltoluene is classified as a Class IIIA combustible liquid.

(6) Sources of ignition such as smoking or open flames are prohibited where p-tert-butyltoluene presents a fire or explosion hazard.

(7) p-tert-butyltoluene shall be stored so as not to come in contact with strong oxidizing agents.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid p-tert-butyltoluene. Face shields shall comply with § 1910.133 (a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with p-tert-butyltoluene be removed promptly and not reworn until the p-tert-butyltoluene is removed from the clothing.

(3) Employers shall ensure that clothing wet with p-tert-butyltoluene is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of p-tert-butyltoluene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the p-tert-butyltoluene, the employer shall inform the person performing the operation of the hazardous properties of p-tert-butyltoluene.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a)(2)–(a)(6) where liquid p-tert-butyltoluene may contact the eyes.

(g) *Spills and disposal.* In the event that liquid p-tert-butyltoluene is spilled the employer shall provide available ventilation, and then clean up the spill.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with p-tert-butyltoluene promptly wash or shower with soap or mild detergent to remove any p-tert-butyltoluene from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which p-tert-butyltoluene is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to p-tert-butyltoluene above the action level or employees who have skin contact with liquid p-tert-butyltoluene or employees who work where p-tert-butyltoluene presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for p-tert-Butyltoluene (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to p-tert-butyltoluene;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to p-tert-butyltoluene which are listed in Appendix A of this section; and

(iv) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to p-tert-butyltoluene.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) *Preplacement medical examination.* The employer shall make available to each employee who is exposed, or will be exposed, to liquid p-tert-butyltoluene or to airborne concentrations of p-tert-butyltoluene at or above the action level, without regard to the use of respirators, a preplacement medical examination which must include as a minimum the following:

(i) A medical history and physical examination with emphasis on the blood, heart, and central nervous system;

(ii) a blood count to include at least a hemoglobin, hematocrit, white and red cell count and a differential smear;

(iii) an electrocardiogram.

(3) *Periodic medical examination.* The employer shall make available to each employee exposed to liquid p-tert-butyltoluene or to airborne concentrations of p-tert-butyltoluene at or above the action level, without regard to the use of

respirators, six months from the date of the employee's first exposure, and every six months thereafter, a periodic medical examination which must include the following:

(i) A medical history and physical examination referrable to the hemopoietic system;

(ii) A blood count to include at least a hemoglobin, hematocrit, white and red cell count and a differential smear:

(iii) An electrocardiogram.

(4) *Alternative medical procedures.* If the examining physician chooses to use alternative medical procedures to those specified in paragraphs (j)(2) and (j)(3) of this section, the employer may accept such alternative medical procedures as meeting the requirements of this section provided that the employer:

(i) Obtains a statement from the examining physician setting forth the alternative medical procedures, the rationale for substitution, and evidence that they will be equally effective.

(ii) Informs each exposed worker of the fact that alternative medical procedures to those required in paragraphs (j)(2) and (j)(3) of this section are to be made available.

(5) *Interim medical examination.* The employer shall provide an interim medical examination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to p-tert-butyltoluene which are listed in Appendix A which the employee suspects are caused by exposure to p-tert-butyltoluene.

(6) *Informing the physician.* The employer shall provide to the physician performing any medical examination required by this section the following information:

(i) A copy of this regulation with Appendixes A, B, and C for p-tert-butyltoluene;

(ii) A description of the affected employee's duties as they relate to his exposure to p-tert-butyltoluene;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(7) Where a medical examination is required by paragraphs (j)(2), (j)(3), or (j)(5) of this section, following such examination the employer shall obtain from the examining physician a written opinion which conforms with paragraph (j)(8) of this section.

(8) *Physician's written opinion.* (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to p-tert-butyltoluene or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to p-tert-butyltoluene, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to p-tert-butyltoluene.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(9) *Results of tests.* Where a preplacement or periodic medical examination is required by paragraphs (j)(2) or (j)(3) of this section, following such examination the employer shall obtain from the examining physician:

(i) A recording of the complete blood count;

(ii) A recording of the electrocardiogram;

(iii) Where alternative medical procedures have been performed in accordance with paragraph (j)(4) of this section, a recording of such alternative procedures.

(10) No employee shall be exposed to liquid p-tert-butyltoluene or airborne concentrations of p-tert-butyltoluene in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(11) No medical procedure which would be performed pursuant to paragraphs (j)(2) or (j)(3) of this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(12) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(13) The employer shall provide emergency medical treatment for any employee injured through exposure to p-tert-butyltoluene.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to p-tert-butyltoluene.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to p-tert-butyltoluene which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (l) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Any employee medical complaints relative to exposure to p-tert-butyltoluene;

(B) A copy of information provided to the physician pursuant to paragraph (j)(6)(ii), (iii), (iv), (v), and (vi) of this section;

(C) Results of tests required by paragraphs (j)(2) and (j)(3) of this section and results of any tests conducted pursuant to paragraph (j)(4) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section

shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to p-tert-butyltoluene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to p-tert-butyltoluene requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne p-tert-butyltoluene that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1032 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR P-TERT-BUTYLTOLUENE

I. SUBSTANCE IDENTIFICATION

A. Substance: p-tert-Butyltoluene.

B. Permissible Exposure: 10 parts of p-tert-butyltoluene per million parts of air (ppm) (60 milligrams of p-tert-butyltoluene per cubic meter of air (mg/cu m)), averaged over an eight-hours work shift (time weighted average).

C. Appearance and Odor: A clear, colorless liquid with a distinct, aromatic odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: p-tert-Butyltoluene can affect your body if it is inhaled, swallowed or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-Term Exposure: p-tert-Butyltoluene may cause irritation of the eyes, nose, throat, and skin. It may also cause nausea, headache, and weakness.

2. Long-Term Exposure: Prolonged or repeated exposure to p-tert-butyltoluene may cause heart changes, blood changes, and skin rash.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by p-tert-butyltoluene exposure.

III. EMERGENCY FIRST AND PROCEDURES

A. Eye Exposure: If p-tert-butyltoluene gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If p-tert-butyltoluene gets on your skin promptly wash the contaminated skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of p-tert-butyltoluene move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When p-tert-butyltoluene has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to p-tert-butyltoluene. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell p-tert-butyltoluene while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid p-tert-butyltoluene.

C. Eye Protection: You must wear splashproof safety goggles where eye contact to liquid p-tert-butyltoluene may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

p-tert-Butyltoluene is a combustible liquid and its vapors can form explosive mixtures in air at elevated temperatures. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever p-tert-butyltoluene is handled, used, or stored in a manner that could create a fire or explosion hazard. If your skin becomes contaminated with p-tert-butyltoluene, you must promptly wash or shower using soap or mild detergent to remove any p-tert-butyltoluene from your skin. You must promptly remove any clothing that becomes contaminated with liquid p-tert-butyltoluene and this clothing must not be reworn until the p-tert-butyltoluene has been removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where p-tert-butyltoluene is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1032 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR P-TERT BUTLYTOLUENE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification.

1. Synonyms: 1-(1,1-Dimethylethyl)-4-methyl-benzene; 1-methyl-4-tert-butylbenzene; p-methyl-tert-butylbenzene; and TBT.

2. Formula: p-CH3C6H4C4H9.

3. Molecular weight: 148.1.

B. Physical Data.

1. Boiling point (760 mm Hg): 193 C (380 F).

2. Specific gravity (water=1): 0.86.

3. Vapor density (air=1): 5.1.

4. Melting point: —52.5 C (—62 F).

5. Vapor pressure at 20 C (68 F): Less than 1 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): Insoluble.

7. Evaporation rate (butyl acetate=1): very low.

8. Appearance and odor: A clear, colorless liquid with a distinct, aromatic odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 60 C (141 F) (closed cup).

2. Autoignition temperature: Data not available.

3. Flammable limits in air, % by volume: Lower: Data not available.

4. Extinguishing media: Foam, dry chemical, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: p-tert-Butyltoluene is a combustible liquid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when p-tert-butyltoluene is used, handled, and stored, in a manner that could create a fire or explosion hazard. p-tert-Butyltoluene vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the p-tert-butyltoluene is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, p-tert-butyltoluene is classified as a Class IIIA combustible liquid.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for p-tert-butyltoluene shall be Class I, Group D.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving p-tert-butyltoluene.

4. Special Precautions: None.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If p-tert-butyltoluene is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.

2. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or a similar material and disposed of in a sanitary landfill. Liquid p-tert-butyltoluene may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods: p-tert-Butyltoluene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of p-tert-butyltoluene to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of p-tert-butylotoluene to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified persons.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to p-tert-butyltoluene can occur when transferring the liquid from one container to another.

B. Store p-tert-butyltoluene in tightly closed containers in a cool well ventilated area away from ignition sources and strong oxidizing agents.

C. Employers must advise employees of all plant areas and operations where exposures to p-tert-butyltoluene could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to p-tert-butyltoluene is likely to occur are where it is synthesized from toluene and isobutylene, where it is purified and packaged, and where it is used as a solvent, oil additive, perfume fixative and intermediate in the synthesis of pharmaceuticals and resins.

NOTE.—The information contained in Appendix C to § 1910.1032 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES, P-TERT-BUTYLTOLUENE

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

The main toxic effects of p-tert-butyltoluene are irritation of the skin and respiratory tract. p-tert-Butyltoluene may depress the central nervous system and the bone marrow. In some exposed employees a cardiovascular syndrome characterized by decreased blood pressure, increased pulse rate, and abnormal response to the Master's Exercise Test has been observed.

III. SIGNS AND SYMPTOMS

Irritation of the eyes and skin, dryness of the nose and throat, headache, decreased blood pressure, tachycardia and abnormal response to tests of cardiovascular stress; central nervous system depression and possible hematopoietic depression.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

p-tert Butyltoluene is reported to be associated with toxic effects on various organs. It is important that the physician become familiar with operating conditions in which exposure to p-tert-butyltoluene occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement Examination.

The following medical procedures must be made available to each employee who is exposed to p-tert-butyltoluene.

1. A complete history and physical examination. The purpose is to detect pre-existing conditions that might place the exposed person at increased risk, and to establish a baseline for future health monitoring. Examination of the cardiovascular and the central nervous systems should be stressed. The skin should be examined for evidence of chronic disorders.

2. An electrocardiogram. This compound has been observed to cause an unusual cardiovascular syndrome in some workmen after occupational exposure. This consisted of decreased blood pressure, increased pulse rate, and failure to respond to the Master's Test of cardiac fitness in a satisfactory manner.

3. Complete blood count. This compound has been shown to cause depression of the bone marrow in rats exposed repeatedly to vapor in concentrations of up to 30 ppm. A complete blood count must be performed, including a differential count of a stained blood smear, as well as hemoglobin, hematocrit, and clotting time determinations.

C. Periodic Examination.

The above medical examinations are to be repeated on a semi-annual basis.

D. Interim Examinations.

If the employer is informed by the employee of the development of any signs or symptoms of exposure to p-tert-butyltoluene which the employee suspects are caused by such exposure, the employer must refer such employee for an interim examination.

VII. REFERENCES

1. Hine, Charles H., et al.: "Toxicological Studies on F-tertiary-butyltoluene." Archives of Industrial Hygiene and Occupational Health, 9:227–244 (1954).

2. Browning, Ethel: Toxicology and Metabolism of Industrial Solvents, Elsevier Publishing Company, New York, 1965, pp. 107–110.

## § 1910.1033 Cumene.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of cumene, not in excess of 50 parts per million (ppm) (245 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z–1.

(2) "Action level" means one half of the permissible exposure for cumene.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which cumene is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of cumene at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of cumene.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to cumene;

(ii) Any measurements of cumene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to cumene; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to cumene at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to cumene at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to cumene at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to cumene above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to cumene above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to cumene below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(e) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration | Required accuracy (percent) |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to cumene above the permissible exposure as defined in paragraph (a) (1) of this section.

(2) Employee exposures to airborne concentrations of cumene shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d) (4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of cumene.

(ii) Where a fan is located in ductwork and where cumene is present in the ductwork in concentrations greater than 2200 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(iii) In the design of open-surface tank ventilation for the purposes of § 1910.94(d), operations involving cumene shall be classified as B-3 at 21 C (70 F).

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of cumene to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Cumene.*

| Condition or vapor concentration | Respiratory protection |
|---|---|
| 500 p/m or less | Chemical cartridge respirator with organic vapor cartridge(s).<br>Supplied-air respirator.<br>Self-contained breathing apparatus. |
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge(s). |
| 2,500 p/m or less | Gas mask with chin-style or front- or back-mounted organic vapor canister.<br>Supplied-air respirator with a full facepiece, hood, or helmet.<br>Self-contained breathing apparatus with a full facepiece. |
| 5,000 p/m or less | Type C supplied-air respirator operated in pressure-demand or other positive pressure mode or continuous-flow mode. |
| Greater than 5,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode.<br>A combination respirator with a full facepiece operated in the pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors.<br>Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for cumene.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of cumene shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, cumene is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of cumene shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid cumene is classified as a Class II combustible liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Sources of ignition such as smoking or open flames are prohibited where cumene presents a fire or explosion hazard.

(9) Cumene shall be stored so as not to come in contact with strong oxidizing agents.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid cumene. Face shields shall comply with § 1910.133(a) (2), (a) (4), (a) (5), and (a) (6).

(2) Employers shall ensure that clothing wet with cumene is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of cumene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cumene, the employer shall inform the person performing the operation of the hazardous properties of cumene.

(3) Employers shall ensure that nonimpervious clothing which becomes contaminated with cumene be removed promptly and not reworn until the cumene is removed from the clothing.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a) (2)–(a) (6) where liquid cumene may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid cumene is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid cumene shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with cumene promptly wash or shower with soap or mild detergent to remove any cumene from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which cumene is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to cumene above the action level or employees who have skin contact with liquid cumene or employees who work where cumene presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Cumene (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to cumene;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to cumene which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j) (2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to cumene.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid cumene or airborne concentrations of cumene at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j) (2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j) (2) of this section, or any of the signs or symptoms of exposure to cumene which are listed in Appendix A which the employee suspects are caused by exposure to cumene.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B, and C for cumene.

(ii) A description of the affected employee's duties as they relate to his exposure to cumene;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j) (3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j) (6) of this section.

(6) (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to cumene or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to cumene, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to cumene.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid cumene or airborne concentrations of cumene in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to cumene.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.* (1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b) (1) of this section.

(ii) The record shall include the written determination required in paragraph (b) (2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to cumene.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to cumene which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d) (3) (i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j) (2) of this section;

(B) Any employee medical complaints relative to exposure to cumene;

(C) A copy of information provided to the physician pursuant to paragraphs (j) (4) (ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to cumene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to cumene requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne cumene that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1033 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR CUMENE

I. SUBSTANCE IDENTIFICATION

A. Substance: Cumene

B. Permissible Exposure: 50 parts of cumene per million parts of air (ppm) (245 milligrams of cumene per cubic meter of air (mg/cu m)), average over an eight-hour work shift (time weighted average).

C. Appearance and Odor: A clear colorless liquid with a sharp aromatic odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Cumene can affect your body if it is inhaled, swallowed, or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-Term Exposure: Cumene may cause irritation of the skin and eyes. It may also cause dizziness, drowsiness, slight incoordination and unconsciousness.

2. Long-Term Exposure: Prolonged or repeated exposure of the skin to liquid cumene may cause a rash.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by cumene exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If cumene gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If cumene gets on your skin promptly wash the contaminated skin using soap or mild detergent. If cumene soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of cumene move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: If cumene has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to cumene. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell cumene while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid cumene.

C. Eye Protection: You must wear splashproof safety goggles where eye contact with liquid cumene may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

Cumene is a combustible liquid and its vapors can form explosive mixtures in air at elevated temperatures. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever cumene is handled, used, or stored in a manner that could create a fire or explosion hazard. You must use nonsparking tools when opening or closing metal containers of cumene, and containers must be bonded and grounded when pouring or transferring liquid cumene. If your skin becomes contaminated with cumene you must promptly wash or shower using soap or mild detergent to remove any cumene from your skin. You must promptly remove any nonimpervious clothing that becomes contaminated with liquid cumene and this clothing must not be reworn until the cumene has been removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where cumene is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1033 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR CUMENE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 1-Methylethyl-benzene; isopropylbenzene; 2-phenylpropane; and cumol.

2. Formula: $C_6H_5C_3H_7$.

3. Molecular weight: 120.2.

B. Physical Data.

1. Boiling point (760 mm Hg): 152 C (306 F).

2. Specific gravity (water=1): 0.86.

3. Vapor density (air=1): 4.14.

4. Melting point: −96 C (−141 F).

5. Vapor pressure at 20 C (68 F): 6 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): Insoluble.

7. Evaporation rate (butyl acetate=1): Very low.

8. Appearance and odor: A clear, colorless liquid with a sharp aromatic odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 44 C (111 F) (closed cup).

2. Autoignition temperature: 425 C (797 F).

3. Flammable limits in air, % by volume: Lower: 0.9; Upper: 6.5.

4. Extinguishing media: Dry chemical, foam, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Cumene is a combustible liquid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when cumene is used, handled, and stored in a manner that could create a fire or explosion hazard. Cumene vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the cumene is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, cumene is classified as a Class II combustible liquid. For example, 2900 ppm, 25 percent of the lower flammable limit, is one situation in which cumene is considered to be a fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for cumene shall be Class I, Group D.

B. Reactivity

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving cumene.

4. Special Precautions: None.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If cumene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or a similar material and disposed of in a sanitary landfill. Cumene may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

Cumene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of cumene to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV) (A). The method of measurement must determine the concentration of cumene to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to cumene can occur when transferring the liquid from one container to another.

B. Nonsparking tools must be used to open and close metal cumene containers which must then be effectively grounded and bonded prior to pouring.

C. Store cumene in tightly closed containers in a cool well-ventilated area away from ignition sources and strong oxidizing agents.

D. Employers must advise employees of all areas and operations where exposure to cumene could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to cumene is likely to occur are handling of petroleum-based solvents having a boiling range of 150–160 C (300–320 F), manufacture of phenol, and use of paints and enamels where cumene is used as a thinner.

NOTE.—The information contained in Appendix C to § 1910.1033 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR CUMENE

I. ROUTE OF ENTRY

Inhalation; insignificant skin absorption.

II. TOXICOLOGY

The main toxic effect of cumene is irritation of the eyes, skin, and upper respiratory tract. Narcosis has been reported to occur in animals on high exposure.

Chronic exposure of rats above 500 ppm causes congestion of lungs, liver, and kidneys, but no bone marrow changes.

III. SIGNS AND SYMPTOMS

Irritation of eyes and mucous membranes of upper respiratory tract; headache; narcosis leading to coma may occur at sustained high concentrations. Excessive skin contact may produce a dermatitis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General. Most reported effects of cumene are caused by its irritant properties. No bone marrow effects have been reported as in benzene. It is important that the physician become familiar with the operating conditions in which exposure to cumene occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement. Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from cumene exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease: Although cumene is not known as a kidney toxin in humans, kidney damage has been reported in experimental animals. The importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Liver disease: Although cumene is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

3. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of cumene might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

4. Skin disease: Cumene is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of cumene.

C. Periodic Examinations. Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, New York, 1965, pp. 94–97.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II. Toxicology (2nd Ed. Revised), Interscience Publishers, New York, 1962, pp. 1235–1236.

3. Grant, W. Morton: Toxicology of the Eye, Charles C. Thomas ———, Illinois, 1962, pp. 154–155.

## § 1910.1034 Ethyl benzene.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of ethyl benzene, not in excess of 100 parts per million (ppm) (435 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z–I.

(2) "Action level" means one half of the permissible exposure for ethyl benzene.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which ethyl benzene is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of ethyl benzene at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of ethyl benzene.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to ethyl benzene;

(ii) Any measurements of ethyl benzene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to ethyl benzene; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to ethyl benzene at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to ethyl benzene at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed

to ethyl benzene at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to ethyl benzene above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to ethyl benzene above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to ethyl benzene below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| *Concentration* | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to ethyl benzene above the permissible exposure as defined in paragraph (a) (1) of this section.

(2) Employee exposures to airborne concentrations of ethyl benzene shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d) (4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of ethyl benzene.

(ii) Where a fan is located in ductwork and where ethyl benzene is present in concentrations greater than 2500 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(iii) In the design of open-surface tank ventilation for the purposes of § 1910.94(d), operations involving ethyl benzene shall be classified as B–2 at 21 C (70 F).

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of ethyl benzene to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Ethyl Benzene*

| *Condition or vapor concentration* | *Respiratory protection* |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge(s). |
| 5,000 p/m or less | Gas mask with chin-style or front- or back-mounted organic vapor canister. |
| | Supplied-air respirator with a full facepiece, hood, or helmet. |
| | Self-contained breathing apparatus with a full facepiece. |
| Greater than 5,000 p/m or entry and escape from unknown. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| | A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors and particulates. |
| | Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for ethyl benzene.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of ethyl benzene shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, ethyl benzene is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of ethyl benzene shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid ethyl benzene is classified as a Class IB flammable liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Sources of ignition such as smoking or open flames are prohibited where ethyl benzene presents a fire or explosion hazard.

(9) Ethyl benzene shall be stored so as not to come in contact with strong oxidizing agents, acids, alkalies, and ammonia.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective

clothing necessary to prevent repeated or prolonged skin contact with liquid ethyl benzene. Face shields shall comply with § 1910.133 (a)(2), (a)(5), and (a)(6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with ethyl benzene be removed promptly and not reworn until the ethyl benzene is removed from the clothing.

(3) Employers shall ensure that clothing wet with ethyl benzene is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of ethyl benzene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ethyl benzene, the employer shall inform the person performing the operation of the hazardous properties of ethyl benzene.

(4) Employers shall ensure that clothing which becomes wet with liquid ethyl benzene be removed immediately and not reworn until the ethyl benzene is removed from the clothing.

(5) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 910.133 (a)(2)–(a)(6) where liquid ethyl benzene may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid ethyl benzene is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid ethyl benzene shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with ethyl benzene promptly wash or shower with soap or mild detergent to remove any ethyl benzene from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which ethyl benzene is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to ethyl benzene above the action level or employees who have skin contact with liquid ethyl benzene or employees who work where ethyl benzene presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Ethyl Benzene (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to ethyl benzene;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to ethyl benzene which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to ethyl benzene.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid ethyl benzene or airborne concentrations of ethyl benzene at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to ethyl benzene which are listed in Appendix A which the employee suspects are caused by exposure to ethyl benzene.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for ethyl benzene.

(ii) A description of the affected employee's duties as they relate to his exposure to ethyl benzene;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to ethyl benzene or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to ethyl benzene, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to ethyl benzene.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid ethyl benzene or airborne concentrations of ethyl benzene in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to ethyl benzene.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to ethyl benzene.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to ethyl benzene which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section

(B) Any employee medical complaints relative to exposure to ethyl benzene;

(C) A copy of information provided to the physician pursuant to paragraphs (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D). Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to ethyl benzene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to ethyl benzene requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne ethyl benzene that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1034 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

## APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR ETHYL BENZENE

### I. SUBSTANCE IDENTIFICATION

A. Substance: Ethyl benzene

B. Permissible Exposure: 100 parts of ethyl benzene per million parts of air (ppm) (435 milligrams of ethyl benzene per cubic meter of air (mg/cu m)) averaged over an eight-hour work shift (time weighted average).

C. Appearance and Odor: A clear, colorless liquid with an aromatic odor.

### II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Ethyl benzene can affect your body if it is inhaled, swallowed or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-Term Exposure: Ethyl benzene may cause irritation of the eyes, nose, throat and skin. With exposure to high doses, irritating effects may become more pronounced, and you may begin to feel weak, dizzy, drowsy, and become unconscious.

2. Long-Term Exposure: Prolonged or repeated exposure of the skin to liquid ethyl benzene can cause a rash.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are associated with ethyl benzene exposure.

### III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If ethyl benzene gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If ethyl benzene gets on your skin promptly wash the contaminated skin using soap or mild detergent. If ethyl benzene soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of ethyl benzene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When ethyl benzene has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

### IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to ethyl benzene. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell ethyl benzene while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid ethyl benzene.

C. Eye Protection: You must wear splash-proof safety goggles where eye contact to liquid ethyl benzene may occur.

### V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

Ethyl benzene is a flammable liquid and its vapors can easily form explosive mixtures in air. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents, acids, alkalies, and ammonia. Sources of ignition such as smoking and open flames are prohibited wherever ethyl benzene is handled, used, or stored in a manner that could create a fire or explosion hazard. You must use nonsparking tools when opening or closing metal containers of ethyl benzene, and the containers must be bonded and grounded when pouring or transferring the liquid. If your clothing becomes wet with liquid ethyl benzene, you must immediately remove the clothing and not wear it again until the ethyl benzene has been removed. If your skin becomes contaminated with ethyl benzene, you must promptly wash or shower using soap or mild detergent. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where ethyl benzene is used in your work area and for any additional safety and health rules.

### VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1034 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

## APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR ETHYL BENZENE

### I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification.

1. Synonyms: Phenyl ethane; ethyl benzol.

2. Formula: $C_2H_5C_6H_5$.

3. Molecular weight: 106.1.

B. Physical Data.

1. Boiling point (760 mm Hg): 136 C (277 F).

2. Specific gravity (water=1): 0.865.

3. Vapor density (air=1): 3.66.

4. Melting point: −95 C (−139 F).

5. Vapor pressure at 20 C (68 F): 7.1 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): 0.015.

7. Evaporation rate (butyl acetate=1): Less than 1.

Appearance and odor: A clear, colorless liquid with an aromatic odor.

### II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 15 C (59 F) (closed cup).

2. Autoignition temperature: 432 C (810 F).

3. Flammable limits in air, % by volume: Lower 1.0; Upper 6.7.

4. Extinguishing media: Dry chemical, foam, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Ethyl benzene is a flammable liquid. Its vapors can easily form explosive mixtures in air. All ignition sources must be controlled when ethyl benzene is used, handled, and stored in a manner that could create a fire or explosion hazard. Ethyl benzene vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the ethyl benzene is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, ethyl benzene is classified as a Class IB flammable liquid. For example, 2500 ppm, 25 percent of the lower flammable limit, is one situation in which ethyl benzene is considered to be a fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for ethyl benzene shall be Class I, Group D.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving ethyl benzene.

4. Special Precautions: None.

### III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If ethyl benzene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or a similar material and disposed of in a sanitary landfill. Ethyl benzene may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

Ethyl benzene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.

2. By atomizing in a suitable combustion chamber.

### IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The methods of measurement must determine the concentration of ethyl benzene to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of ethyl benzene to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

### V. MISCELLANEOUS PRECAUTIONS

A. High exposure to ethyl benzene can occur when transferring the liquid from one container to another.

B. Nonsparking tools must be used to open and close metal ethyl benzene containers which must then be effectively grounded and bonded prior to pouring.

C. Store ethyl benzene in tightly closed containers in a cool well-ventilated area away from ignition sources and strong oxidizing agents, acids, alkalies, and ammonia.

D. Employers must advise employees of all areas and operations where exposure to ethyl benzene could occur.

### VI. COMMON OPERATIONS

Some common operations in which exposure to ethyl benzene is likely to occur are operations involved in the synthesis of ethyl benzene from benzene and ethylene and in its conversion to styrene by catalytic dehydrogenation. Ethyl benzene is also used as a constituent of motor and aviation fuels and commercial aromatic solvents for paints and lacquers.

NOTE: The information contained in Appendix C to § 1910.1034 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

## APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR ETHYL BENZENE

### I. ROUTE OF ENTRY

Inhalation; insignificant skin absorption.

### II. TOXICOLOGY

Ethyl benzene is primarily an irritant of skin and, to some degree, of eyes and upper respiratory tract. Skin effects from the defatting action of liquid ethyl benezene can occur. Systemic absorption causes depression of the central nervous system with narcosis at high concentrations. Aspiration of small amounts causes extensive edema and hemorrhage of lung tissue. Ethyl benzene is readily metabolized and excreted chiefly as mandelic acid in the urine.

### III. SIGNS AND SYMPTOMS

Irritation of eyes and mucous membranes of upper respiratory tract; headache; narcosis leading to coma may occur at sustained high levels. Excessive skin contract may produce a dermatitis.

### IV. SPECIAL TESTS

None in common usage.

### V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

### VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Most reported effects of ethyl benezene are caused by its irritant properties. No bone marrow effects have been reported as in benezene. It is important that the physician become familiar with operating conditions in which exposure to ethyl benzene occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement.

Routine medical histories and physicial examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from ethyl benzene exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease: Although ethyl benzene is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Liver disease: Although ethyl benzene is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

3. Skin disease: Ethyl benzene is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of ethyl benzene.

4. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of ethyl benzene might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

### VII. REFERENCES

1. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II. Toxicology (2nd Ed. Revised), Interscience Publishers, New York, 1962, pp. 1231–1233.

2. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, New York, 1965, pp. 90–93.

3. Dutkiewicz, Tadeusz and Tyras, Halina: "A Study of Skin Absorption of Ethyl Benzene in Man," British Journal of Industrial Medicine, *24*: 330–332 (1967).

## § 1910.1035 alpha-Methyl styrene.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of alpha-methyl styrene, not in excess of 100 parts per million (ppm) (480 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z–1.

(2) "Action level" means one half of the permissible exposure for alpha-methyl styrene.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which alpha-methyl styrene is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of alpha-methyl styrene at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in air-

borne concentrations of alpha-methyl styrene.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to alpha-methyl styrene;

(ii) Any measurements of alpha-methyl styrene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to alpha-methyl styrene; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to alpha-methyl styrene at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken purusant to paragraph (b)(3) of this section reveals employee exposure to alpha-methyl styrene at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to alpha-methyl styrene at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to alpha-methyl styrene above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to alpha-methyl styrene above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to alpha-methyl styrene below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration | Required accuracy (percent) |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to alpha-methyl styrene above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of alphamethyl styrene shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of alphamethyl styrene.

(ii) Where a fan is located in ductwork and where alphamethyl styrene is present in the ductwork in concentrations greater than 4700 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of alpha-methyl styrene to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for alpha-Methyl Styrene*

| Condition or vapor concentration | Respiratory protection |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge(s). |
| | Gas mask with chin-style or front- or back-mounted organic vapor canister. |
| | Supplied-air respirator with a full facepiece, hood, or helmet. |
| | Self-contained breathing apparatus with a full facepiece. |
| Greater than 5,000 p/m or entry or escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| | A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors. |
| | Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formely Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for alpha-methyl styrene.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence

of alpha-methyl styrene shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, alpha-methyl styrene is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of alpha-methyl styrene shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid alpha-methyl styrene is classified as a Class II combustible liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Sources of ignition such as smoking or open flames are prohibited where alpha-methyl styrene presents a fire or explosion hazard.

(8) alpha-Methyl styrene shall be stored so as not to come in contact with strong oxidizing agents and catalysts for polymerization such as strong acids and aluminum chloride or iron chloride.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid alpha-methyl styrene. Face shields shall comply with § 1910.133 (a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that clothing wet with alpha-methyl styrene is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of alpha-methyl styrene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the alpha-methyl styrene, the employer shall inform the person performing the operation of the hazardous properties of alpha-methyl styrene.

(3) Employers shall ensure that non-impervious clothing which becomes contaminated with alpha-methyl styrene be removed promptly and not reworn until the alpha-methyl styrene is removed from the clothing.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133 (a)(2)–(a)(6) where liquid alpha-methyl styrene may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid alpha-methyl styrene is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid alpha-methyl styrene shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with alpha-methyl styrene promptly wash or shower with soap or mild detergent to remove any alpha-methyl styrene from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which alpha-methyl styrene is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to alpha-methyl styrene above the action level or employees who have skin contact with liquid alpha-methyl styrene or employees who work where alpha-methyl styrene presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for alpha-methyl styrene (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to alpha-methyl styrene;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to alpha-methyl styrene which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to alpha-methyl styrene.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid alpha-methyl styrene or airborne concentrations of alpha-methyl styrene at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to alpha-methyl styrene which are listed in Appendix A which the employee suspects are caused by exposure to alpha-methyl styrene.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for alpha-methyl styrene;

(ii) A description of the affected employee's duties as they relate to his exposure to alpha-methyl styrene;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to alpha-methyl styrene or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to alpha-methyl styrene, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to alpha-methyl styrene.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid alpha-methyl styrene or airborne concentrations of alpha-methyl styrene in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to alpha-methyl styrene.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to alpha-methyl styrene.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to alpha-methyl styrene which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d) (3) (i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j) (2) of this section;

(B) Any employee medical complaints relative to exposure to alpha-methyl styrene;

(C) A copy of information provided to the physician pursuant to paragraphs (j) (4) (ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement*—(1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to alpha-methyl styrene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to alpha-methyl styrene requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne alpha-methyl styrene that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1035 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR ALPHA-METHYL STYRENE

I. SUBSTANCES IDENTIFICATION

A. Substance: alpha-Methyl styrene.

B. Permissible Exposure: 100 parts of alpha-methyl styrene per million parts of air (ppm) (480 milligrams of alpha-methyl styrene per cubic meter of air (mg/cu m)), averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless liquid with a characteristic odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: alpha-Methyl styrene can affect your body if it is inhaled, swallowed or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-Term Exposure: alpha-Methyl styrene may cause irritation of the eyes, nose, and throat. It may also cause drowsiness.

2. Long-Term Exposure: Prolonged or repeated exposure of the skin to liquid alpha-methyl styrene may cause irritation.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by alpha-methyl styrene exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If alpha-methyl styrene gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If alpha-methyl styrene gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If alpha-methyl styrene soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of alpha-methyl styrene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: If alpha-methyl styrene has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to alpha-methyl styrene. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell alpha-methyl styrene while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing, to prevent repeated or prolonged skin contact with liquid alpha-methyl styrene.

C. Eye Protection: You must wear splash-proof safety goggles where eye contact to liquid alpha-methyl styrene may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

alpha-Methyl styrene is a combustible liquid and its vapors can form explosive mixtures in air at elevated temperatures. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever alpha-methyl styrene is handled, used, or stored in a manner that could create a fire or explosion hazard. You must use nonsparking tools when opening or closing metal containers of alpha-methyl styrene and the containers must be bonded and grounded when pouring or transferring the liquid. If your nonimpervious clothing becomes contaminated with alpha-methyl styrene, you must promptly remove the clothing and not wear it again until the alpha-methyl styrene has been removed. If alpha-methyl styrene gets on your skin, you must promptly wash or shower using soap or mild detergent. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where alpha-methyl styrene is used in your work area

and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1035 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR ALPHA-METHYL STYRENE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification.

1. Synonyms: 1-Methylethenyl-benzene, AMS, and isopropenyl benzene.

2. Formula: $C_6H_5C(CH_3)=CH_2$.

3. Molecular weight: 118.1.

B. Physical Data.

1. Boiling point (760 mm Hg): 165 C (329 F).

2. Specific gravity (water=1): 0.92.

3. Vapor density (air=1): 4.1.

4. Melting point: −23 C (−9 F).

5. Vapor pressure at 20 C (68 F): 1.9 mm Hg.

6. Solubility in water, % by weight at 20 C 68 F): Insoluble.

7. Evaporation rate (butyl acetate=1): Less than 1.°

8. Appearance and odor: Colorless liquid with a characteristic odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 54 C (129 F) (closed Cup).

2. Autoignition temperature: 574 C (1066 F).

3. Flammable limits in air, % by volume: Lower 1.9 Upper 6.1.

4. Extinguishing media: Dry chemical, foam, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: alpha-methyl styrene is a combustible liquid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when alpha-methyl styrene is used, handled, and stored in a manner that could create a fire or explosion hazard. Alpha-methyl styrene vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the alpha-methyl styrene is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, alpha-methyl styrene is classified as a Class II combustible liquid. For example, 4700 ppm, 25 percent of the lower flammable limit, is one situation in which alpha-methyl styrene is considered to be a fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for alpha-methyl styrene shall be Class I, Group D.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizing agents (such as peroxides and halogens) may cause fire and explosion. Also avoid contact with catalysts for vinyl polymerization and catalysts for ionic polymerization such as aluminum chloride or iron chloride.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving alpha-methyl styrene.

4. Special Precautions: None.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If alpha-methyl styrene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or a similar material and disposed of in a sanitary landfill. alpha-Methyl styrene may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

alpha-methyl styrene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the averabe 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The methods of measurement must determine the concentration of alpha-methyl styrene to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV) (A). The method of measurement must determine the concentration of alpha-methyl styrene to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to alpha-methyl styrene can occur when transferring the liquid from one container to another.

B. Nonsparking tools must be used to open and close metal alpha-methyl styrene containers which must then be effectively grounded and bonded prior to pouring.

C. Store alpha-methyl styrene in tightly closed containers in a cool well-ventilated area away from ignition sources and strong oxidizing agents.

D. Runaway polymerization of alpha-methyl styrene is not likely unless the material comes in contact with catalysts for ionic polymerization such as aluminum or iron chloride and strong acids.

E. Employers must advise employees of areas and operations where exposure to alpha-methyl styrene could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to alpha-methyl styrene is likely to occur are in making certain polyesters, alkyd resins, copolymers with methyl methacrylate, and homopolymers.

NOTE.—The information contained in Appendix C to § 1910.1035 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR ALPHA-METHYL STYRENE

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Exposure to alpha-methyl styrene causes slight irritation of the eyes, upper respiratory tract, and skin. Prolonged and repeated exposure may result in depression of the central nervous system.

III. SIGNS AND SYMPTOMS

Irritation of eyes, nose, and throat and drowsiness. Prolonged skin contact may produce dermatitis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Most reported effects of alpha-methyl styrene are caused by its irritant properties. It is important that the physician become familiar with operating conditions in which exposure to alpha-methyl styrene occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement.

Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from alpha-methyl styrene exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease: Although alpha-methyl styrene is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Liver disease: Although alpha-methyl styrene is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered

before exposing persons with impaired liver function.

3. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of alpha-methyl styrene might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

4. Skin disease: Alpha-methyl styrene is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of alpha-methyl styrene.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. Wolf, M. A., et al.: "Toxicological Studies of Certain Alkylated Benzenes and Benzene," Archives of Industrial Health, *14*:387–398 (1956).

## § 1910.1036 Styrene.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of styrene not in excess of 100 parts per million (ppm), averaged over an eight-hour work shift (time weighted average); and not in excess of 200 ppm at any time during an eight-hour work shift except that an exposure not exceeding 600 ppm for no more than five minutes every three hours shall be permitted if the TWA is at or below 100 ppm as stated in 1910.1000, Table Z–2.

(2) "Action level" means one half of the permissible eight-hour time weighted average exposure for styrene.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which styrene is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of styrene at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of styrene.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to styrene;

(ii) Any measurements of styrene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to styrene; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to styrene at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to styrene at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If any employee exposure measurement reveals that an employee is exposed to styrene at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to styrene above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to styrene above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to styrene below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE I

| *Concentration* | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to styrene above the permissible exposure as defined in paragraph (a) (1) of this section.

(2) Employee exposures to airborne concentrations of styrene shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d) (4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of styrene.

(ii) Where a fan is located in ductwork and where styrene is present in the ductwork in concentrations greater than 2800 ppm (25% of the lower flammable limit) the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(iii) In the design of open surface tank ventilation for the purpose of § 1910.94(d), operations involving styrene shall be classified as B–3 at 21 C (70 F).

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of styrene to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Styrene*

| *Condition or Vapor concentration* | *Respiratory protection* |
|---|---|
| 400 p/m or less | Chemical cartridge respirator with organic vapor cartridge(s).<br>Supplied-air respirator.<br>Self-contained breathing apparatus. |
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge(s). |
| 5,000 p/m or less | Gas mask with chin style or front- or back-mounted organic vapor canister.<br>Supplied-air respirator with a full facepiece, hood or helmet.<br>Self-contained breathing apparatus with a full facepiece. |
| Greater than 5,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode.<br>A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors.<br>Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for styrene.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of styrene shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, styrene is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of styrene shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid styrene is classified as a Class IC flammable liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Sources of ignition such as smoking or open flames are prohibited where styrene presents a fire or explosion hazard.

(9) Styrene shall be stored so as not to come in contact with oxidizing agents and catalysts for polymerization such as peroxides, strong acids, and aluminum chloride. After 30 days of storage, the monomer shall be checked at least weekly to determine the inhibitor content.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid styrene. Face shields shall comply with § 1910.133 (a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with styrene be removed promptly and not reworn until the styrene is removed from the clothing.

(3) Employers shall ensure that clothing which becomes wet with liquid styrene be removed immediately and not reworn until the styrene is removed from the clothing.

(4) Employers shall ensure that clothing wet with styrene is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of styrene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the styrene, the employer shall inform the person performing the operation of the hazardous properties of styrene.

(5) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a)(2)–(a)(6) where liquid styrene may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid styrene is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid styrene shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with styrene promptly wash or shower with soap or mild detergent to remove any styrene from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which styrene is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to styrene above the action level or employees who have skin contact with liquid styrene or employees who work where styrene presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Styrene (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to styrene;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to styrene which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to styrene.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid styrene or airborne concentrations of styrene at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease;

(v) Central nervous system disorders.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to styrene which are listed in Appendix A which the employee suspects are caused by exposure to styrene.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B, and C for styrene.

(ii) A description of the affected employee's duties as they relate to his exposure to styrene;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to styrene or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to styrene, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to styrene.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid styrene or airborne concentrations of styrene in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to styrene.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to styrene.

(ii) This record shall include;

(A) The date of measurement;

(B) Operations involving exposure to styrene which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to styrene;

(C) A copy of information provided to the physician pursuant to paragraphs (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to styrene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to styrene requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne styrene that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1036 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR STYRENE

I. SUBSTANCE IDENTIFICATION

A. Substance: Styrene

B. Permissible Exposure: 100 parts per million (ppm), averaged over an eight-hour work shift (time weighted average); and not in excess of 200 ppm at any time during an eight-hour work shift except that an exposure not exceeding 600 ppm for no more than five minutes every three hours shall be permitted if the TWA is at or below 100 ppm.

C. Appearance and Odor: A clear, colorless liquid with a sweet, pleasant odor in very low concentrations but a disagreeable odor at higher concentrations.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Styrene can affect your body if it is inhaled, swallowed or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-Term Exposure: Styrene may cause irritation of the eyes, nose, throat and skin. Exposure to high concentrations may cause sleepiness or unconsciousness.

2. Long-Term Exposure: Prolonged or repeated exposure of the skin to liquid styrene may cause a rash.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by styrene exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If styrene gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If styrene gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If styrene soaks through your clothing, remove the clothing promptly and wash the skin using soap or

mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of styrene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When styrene has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to styrene. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell styrene while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid styrene.

C. Eye Protection: You must wear splash-proof safety goggles where eye contact to liquid styrene may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

Styrene is a flammable liquid and its vapors can easily form explosive mixtures in air. It must be stored in tightly closed mild steel containers, in a cool, well-ventilated area away from ignition sources, strong acids, oxidizing agents, peroxides, aluminum chloride, and polymerization catalysts. Sources of ignition such as smoking and open flames are prohibited wherever styrene is handled, used, or stored in a manner that could create a fire or explosion hazard. You must use nonsparking tools when opening or closing metal containers of styrene, and the containers must be bonded and grounded when pouring or transferring the liquid. If your clothing becomes wet with liquid styrene, you must immediately remove the clothing and not wear it again until the styrene has been removed. If styrene gets on your skin, you must promptly wash or shower using soap or mild detergent. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where styrene is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1036 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR STYRENE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Ethenyl benzene, phenylethylene, vinyl benzene; cinnamene; cinnamenol; cinnamol; styrene monomer; styrol; and styrolene.

2. Formula: $C_6H_5CH=CH_2$.

3. Molecular weight: 118.1.

B. Physical Data

1. Boiling point (760 mm Hg): 145 C (293 F).

2. Specific gravity (water=1): 0.90.

3. Vapor density (air=1): 3.6.

4. Melting point: −30.6 C (−23 F).

5. Vapor pressure at 20 C (68 F): 4.5 mm Hg.

6. Solubility in water, percent by weight at 20 C (68 F): 0.03.

7. Evaporation rate (butyl acetate=1): 0.49.

8. Appearance and odor: A clear, colorless liquid with a sweet, pleasant odor in very low concentrations but a disagreeable odor at higher concentrations.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 32 C (90 F) (closed cup).

2. Autoignition temperature: 490 C (914 F).

3. Flammable limits in air, % by volume: Lower 1.1 Upper 6.1.

4. Extinguishing media: Dry chemical, foam, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire. Large fires must be fought from a distance, or from protected locations. Polymerization is accelerated by temperatures above 66 C (150 F). Fumes from styrene fires are very acrid.

6. Unusual fire and explosion hazards: Styrene is a flammable liquid. Its vapors can easily form explosive mixtures in air. All ignition sources must be controlled when styrene is used, handled, and stored in a manner that could create a fire or explosion hazard. Styrene vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the styrene is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, styrene is classified as a Class IC flammable liquid. For example, 2800 ppm, 25 percent of the lower flammable limit, is one situation in which styrene is considered to be a potential fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for styrene shall be Class I, Group D.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with oxidizing agents and catalysts for vinyl polymerization such as peroxides, strong acids, and aluminum chloride may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving styrene.

4. Special Precautions: Styrene will corrode copper, copper alloys, and dissolve rubber. Styrene in storage should be stabilized by a polymerization inhibitor (for example, tert-butylcatechol). If this is not present in adequate concentrations, styrene can polymerize and explode its container. The polymerization is accelerated by temperatures above 66 C (150 F).

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If styrene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or a similar material and disposed of in a sanitary landfill. Styrene may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

Styrene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary landfill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of styrene to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of styrene to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to styrene can occur when transferring the liquid from one container to another.

B. Nonsparking tools must be used to open and close metal styrene containers which must then be effectively grounded and bonded prior to pouring.

C. Store styrene in tightly closed mild steel containers in a cool well-ventilated area

away from ignition sources, oxidizing agents, and polymerization catalysts.

D. Styrene vapors are not inhibited. They can polymerize and clog tank vents and flame arresters.

E. Employers must advise employees of areas and operations where exposure to styrene could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to styrene is likely to occur are in the manufacture of synthetic rubber latex, polyester resins (as in glass-reinforced boat hulls), ion-exchange resins, styrenated oil and styrene molding compounds.

NOTE.—The information contained in Appendix C to § 1910.1036 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR STYRENE

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Styrene may cause irritation of the eyes and upper respiratory tract. There is cracking and inflammation of the skin due to defatting. Central nervous system depression may occur on exposure to high concentrations; and electroencephalographic changes have been reported. Styrene is excreted fairly rapidly in the urine, largely as hippuric acid.

III. SIGNS AND SYMPTOMS

Irritation of eyes and nose; drowsiness, weakness, unsteady gait; narcosis; and defatting dermatitis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Most reported effects of styrene are caused by its irritant properties. The possibility of significant skin absorption should also be considered. It is important that the physician become familiar with the conditions in which exposure to styrene occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement.

Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from styrene exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Central nervous system disorders: Since exposure to styrene vapor or liquid on the skin has been observed to result in central nervous system depression and occasional abnormalities in the electroencephalogram, persons with pre-existing neurologic disorders may be unusually susceptible to these effects.

2. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, inhalation of styrene vapor might cause exacerbation of symptoms due to its irritant properties or to psychic reflex bronchospasm.

3. Skin disease: Styrene is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of styrene.

4. Renal disease: Although styrene is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metobalites justifies special consideration in those with possible impairment of renal function.

5. Liver disease: Although styrene is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. Dutkiewicz, Tadeusz and Tyras, Halina: "Skin Absorption of Toluene, Styrene, and Xylene by Man," British Journal of Industrial Medicine, 25:243 (1968).

2. Zielhuis, R. L.: "Systemic Toxicity from Exposure to Epoxy Resins, Hardeners, and Styrene," Journal of Occupational Medicine, 3:25–29 (1961).

3. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, New York, 1965, pp. 98–102.

4. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II Toxicology (2nd Ed. Revised), Interscience Publishers, New York, 1962, pp. 1229–1231.

## § 1910.1037 Vinyl Toluene.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of vinyl toluene, not in excess of 100 parts per million (ppm) (480 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z–1.

(2) "Action level" means one half of the permissible exposure for vinyl toluene.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which vinyl toluene is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of vinyl toluene at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of vinyl toluene.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to vinyl toluene;

(ii) Any measurements of vinyl toluene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to vinyl toluene; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to vinyl toluene at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to vinyl toluene at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to vinyl toluene at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to vinyl toluene above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to vinyl toluene above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to vinyl toluene below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration | Required accuracy (percent) |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to vinyl toluene above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of vinyl toluene shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of vinyl toluene.

(ii) Where a fan is located in ductwork and where vinyl toluene is present in the ductwork in concentrations greater than 2000 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of vinyl toluene to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Vinyl Toluene*

| *Condition or vapor concentration* | *Respiratory protection* |
|---|---|
| 400 p/m or less | Chemical cartridge respirator with organic vapor cartridge(s).<br>Supplied-air respirator.<br>Self-contained breathing apparatus. |
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge(s). |
| 5,000 p/m or less | Gas mask with chin-style or front- or back-mounted organic vapor canister.<br>Supplied-air respirator with a full facepiece, hood, or helmet.<br>Self-contained breathing apparatus with a full facepiece. |
| Greater than 5,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode.<br>A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode and auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus wtih a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors.<br>Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for vinyl toluene.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of vinyl toluene shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, vinyl toluene is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 190.178, locations classified as hazardous locations due to the presence of vinyl toluene shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid vinyl toluene is classified as a Class II combustible liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Sources of ignition such as smoking or open flames are prohibited where vinyl toluene presents a fire or explosion hazard.

(8) Vinyl toluene shall be stored so as not to come in contact with oxidizing agents and catalysts for polymerization such as peroxides, strong acids, and aluminum chloride. After 30 days of storage the monomer shall be checked at least weekly to determine the inhibitor content.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid vinyl toluene. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that clothing wet with vinyl toluene is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of vinyl toluene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the vinyl toluene, the employer shall inform the person performing the operation of the hazardous properties of vinyl toluene.

(3) Employers shall ensure that nonimpervious clothing which becomes contaminated with vinyl toluene be removed promptly and not reworn until the vinyl toluene is removed from the clothing.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a)((2)-(a)(6) where liquid vinyl toluene may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid vinyl toluene is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid vinyl toluene shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with vinyl toluene promptly wash or shower with soap or mild detergent to remove any vinyl toluene from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which vinyl toluene is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to vinyl toluene above the action level or employees who have skin contact with liquid vinyl toluene or employees who work where vinyl toluene presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Vinyl Toluene (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to vinyl toluene;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to vinyl toluene which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j) (2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to vinyl toluene.

(j) *Medical surveillance.* (1) the employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid vinyl toluene or airborne concentrations of vinyl toluene at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j) (2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j) (2) of this section, or any of the signs or symptoms of exposure to vinyl toluene which are listed in Appendix A which the employee suspects are caused by exposure to vinyl toluene.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B, and C for vinyl toluene.

(ii) A description of the affected employee's duties as they relate to his exposure to vinyl toluene;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j) (3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j) (6) of this section.

(6) (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to vinyl toluene or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to vinyl toluene, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to vinyl toluene.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid vinyl toluene or airborne concentrations of vinyl toluene in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to vinyl toluene.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b) (1) of this section.

(ii) The record shall include the written determination required in paragraph (b) (2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to vinyl toluene.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to vinyl toluene which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d) (3) (i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j) (2) of this section;

(B) Any employee medical complaints relative to exposure to vinyl toluene;

(C) A copy of information provided to the physician pursuant to paragraphs (j) (4) (ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to vinyl toluene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to vinyl toluene

requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne vinyl toluene that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1037 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR VINYL TOLUENE

I. SUBSTANCE IDENTIFICATION

A. Substance: Vinyl toluene.

B. Permissible Exposure: 100 parts of vinyl toluene per million parts of air (ppm) (480 milligrams of vinyl toluene per cubic meter of air (mg/cu m)), averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless liquid with a disagreeable odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Vinyl toluene can affect your body if it is inhaled, swallowed or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-Term Exposure: Vinyl Toluene may cause irritation of the nose, throat, eyes, and skin. It may also cause drowsiness.

2. Long-Term Exposure: Prolonged or repeated skin contact to liquid vinyl toluene may cause dryness and irritation.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by vinyl toluene exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If vinyl toluene gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If vinyl toluene gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If vinyl toluene soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of vinyl toluene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When vinyl toluene has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to vinyl toluene. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell vinyl toluene while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid vinyl toluene.

C. Eye Protection: You must wear splash-proof safety goggles where eye contact to liquid vinyl toluene may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

Vinyl toluene is a combustible liquid and its vapors can form explosive mixtures in air at elevated temperatures. It must be stored in tightly closed mild steel containers in a cool, well-ventilated area away from ignition sources, strong acids, oxidizing agents, peroxides, aluminum chloride, and polymerization catalysts. Sources of ignition such as smoking and open flames are prohibited wherever vinyl toluene is handled, used, or stored in a manner that could create a fire or explosion hazard. You must use nonsparking tools when opening or closing metal containers of vinyl toluene, and the containers must be bonded and grounded when pouring or transferring the liquid. If your nonimpervious clothing becomes contaminated with vinyl toluene, you must promptly remove the clothing and not rewear it until the vinyl toluene has been removed. If vinyl toluene gets on your skin, you must promptly wash or shower using soap or mild detergent. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where vinyl toluene is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1037 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR VINYL TOLUENE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification.

1. Synonyms: 1-Ethenyl-4-methyl-benzene; methyl styrene; tolyl ethylene; mixed isomers of meta- and para-vinyl toluene.

2. Formula: $CH_3C_6H_4CH{=}CH_2$.

3. Molecular weight: 118.1.

B. Physical Data.

1. Boiling point (760 mm Hg): 168 C (334 F).

2. Specific gravity (water=1): 0.92.

3. Vapor density (air=1): 4.1.

4. Melting point: −77 C (−106 F).

5. Vapor pressure at 20 C (68 F): 1.1 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F: 0.009.

7. Evaporation rate (butyl acetate=1): Less than 0.5.

8. Appearance and odor: Colorless liquid with a disagreeable odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 53 C (127 F) (closed cup).

2. Autoignition temperature: 496 C (923 F).

3. Flammable limits in air, % by volume: Lower: 0.8 Upper: 11.

4. Extinguishing media: Dry chemical, foam, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to keep containers exposed to a fire cool. Large fires must be fought from a distance, or from protected locations.

6. Unusual fire and explosion hazards: Vinyl toluene is a combustible liquid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when vinyl toluene is used, handled, and stored in a manner that could create a fire or explosion hazard. Vinyl toluene vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the vinyl toluene is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, vinyl toluene is classified as a Class II combustible liquid. For example, 2000 ppm, 25 percent of the lower flammable limit, is one situation in which vinyl toluene is considered to be a fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for vinyl toluene shall be Class I, Group D.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with oxidizing agents may cause fire and explosions. Also, contact with catalysts for vinyl polymerization, such as peroxides, strong acids and aluminum chloride must be avoided.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving vinyl toluene.

4. Special Precautions: Vinyl toluene in storage should be stabilized by a polymerization inhibitor (for example, 10–50 ppm of tert-butylcatechol). If this is not present in adequate concentrations, vinyl toluene can polymerize and explode its container.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If vinyl toluene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or a similar material and disposed of in a sanitary landfill. Vinyl toluene may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

Vinyl toluene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above The Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of vinyl toluene to plus or minus 35%.

B. Exposure Above The Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of vinyl toluene to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to vinyl toluene can occur when transferring the liquid from one container to another.

B. Nonsparking tools must be used to open and close metal vinyl toluene containers which must then be effectively grounded and bonded prior to pouring.

C. Store vinyl toluene in tightly closed mild steel containers in a cool well-ventilated area away from ignition sources, oxidizing agents, and polymerization catalysts.

E. Vinyl toluene vapors are not inhibited. They can polymerize and clog tank vents and flame arresters.

F. Employers must advise employees of areas and operations where exposure to vinyl toluene could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to vinyl toluene is likely to occur are during surface-spray coating, extrusion molding and injection molding.

NOTE.—The information contained in Appendix C to § 1910.1037 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR VINYL TOLUENE

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

The main toxic effect of vinyl toluene is irritation of the eyes and upper respiratory tract, and skin. With prolonged and repeated contact and absorption of high doses, there may be depression of the central nervous system.

III. SIGNS AND SYMPTOMS

Irritation of the eyes, skin and upper respiratory tract. Drowsiness may occur at high levels of exposure.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Very little has been reported on this compound; however, reported effects of vinyl toluene are caused by its irritant properties. It is important that the physician become familiar with operating conditions in which exposure to vinyl toluene occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement.

Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from vinyl toluene exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease: Although vinyl toluene is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Liver disease: Although vinyl toluene is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

3. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of vinyl toluene might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

4. Skin disease: Vinyl toluene is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of vinyl toluene.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. Wolf, M.A., et al.: "Toxicological Studies of Certain Alkylated Benzenes and Benzene," Archives of Industrial Health, *14*:387–398 (1956).

**§ 1910.1038 Cyclohexane.**

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of cyclohexane, not in excess of 300 parts per million (ppm) (1,050 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z–1.

(2) "Action level" means one half of the permissible exposure for cyclohexane.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which cyclohexane is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of cyclohexane at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of cyclohexane.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to cyclohexane;

(ii) Any measurements of cyclohexane taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to cyclohexane; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to cyclohexane at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to cyclohexane at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employee so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to cyclohexane at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to cyclohexane above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to cyclohexane above the permissible exposure. The employee shall also be notified of the corrective

action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to cyclohexane below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| *Concentration* | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to cyclohexane above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of cyclohexane shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of cyclohexane.

(ii) Where a fan is located in ductwork and where cyclohexane is present in concentrations greater than 3300 ppm, (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(iii) In the design of open surface tank ventilation for the purposes of § 1910.94(d), operations involving cyclohexane shall be classified as B-1 at 21 C (70 F).

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of cyclohexane to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Cyclohexane*

| *Condition or vapor concentration* | *Respiratory protection* |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with a full facepiece and organic vapor cartridge(s). |
| 5,000 p/m or less | Gas mask with a chin-style organic vapor canister. |
| 10,000 p/m or less | Gas mask with front- or back-mounted organic vapor canister. |
| | Supplied-air respirator with a full facepiece, hood, or helmet. |
| | Self-contained breathing apparatus with a full facepiece. |
| Greater than 10,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| | A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors. |
| | Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for cyclohexane.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of cyclohexane shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, cyclohexane is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of cyclohexane shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid cyclohexane is classified as a Class IB flammable liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Sources of ignition such as smoking or open flames are prohibited where cyclohexane presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid cyclohexane. Face shields shall comply with § 1910.133 (a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that clothing which becomes wet with cyclohexane be removed immediately and not reworn until the cyclohexane is removed from the clothing.

(3) Employers shall ensure that clothing wet with cyclohexane is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of cyclohexane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyclohexane, the employer shall inform the person performing the operation of the hazardous properties of cyclohexane.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a)(2)–(a)(6) where liquid cyclohexane may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid cyclohexane is spilled the employer shall immediately eliminate po-

tential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid cyclohexane shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes wet with cyclohexane promptly wash or shower to remove any cyclohexane from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which cyclohexane is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to cyclohexane above the action level or employees who have skin contact with liquid cyclohexane or employees who work where cyclohexane presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Cyclohexane (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to cyclohexane;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to cyclohexane which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to cyclohexane.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid cyclohexane or airborne concentrations of cyclohexane at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to cyclohexane which are listed in Appendix A which the employee suspects are caused by exposure to cyclohexane.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B, and C for cyclohexane.

(ii) A description of the affected employee's duties as they relate to his exposure to cyclohexane;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6) (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increase risk of material impairment of the employee's health from exposure to cyclohexane or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to cyclohexane, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to cyclohexane.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid cyclohexane or airborne concentrations of cyclohexane in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to cyclohexane.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to cyclohexane.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to cyclohexane which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to cyclohexane;

(C) A copy of information provided to the physician pursuant to paragraphs (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to cyclohexane which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to cyclohexane requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne cyclohexane that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1038 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR CYCLOHEXANE

I. SUBSTANCE IDENTIFICATION

A. Substance: Cyclohexane.

B. Permissible Exposure: 300 parts of cyclohexane per million parts of air (ppm) (1,050 milligrams of cyclohexane per cubic meter of air (mg/cu m)), averaged over an eight-hour work shift (time weighted average).

C. Appearance and Odor: Colorless liquid with a mild, sweet odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Cyclohexane can affect your body if it is inhaled, swallowed or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-Term Exposure: Exposure to cyclohexane may cause dizziness and nausea. High levels of exposure may cause unconsciousness. Splashes of liquid cyclohexane may irritate the eyes.

2. Long-Term Exposure: Prolonged or repeated exposure to liquid cyclohexane may cause drying and irritation of the skin.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by cyclohexane exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposures: If cyclohexane gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If cyclohexane gets on your skin wash it off. Cyclohexane soaks through your clothing, remove the clothing promptly and wash the skin. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of cyclohexane move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: If cyclohexane has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to cyclohexane. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approved label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell cyclohexane while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid cyclohexane.

C. Eye Protection: You must wear splashproof safety goggles where eye contact with liquid cyclohexane may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

Cyclohexane is a flammable liquid and its vapors can easily form explosive mixtures in air. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever cyclohexane is handled, used, or stored in a manner that could create a fire or explosion hazard. You must use nonsparking tools when opening or closing metal containers of cyclohexane and the containers must be bonded and grounded when pouring or transferring the liquid. If your skin becomes wet with cyclohexane you must promptly wash or shower to remove any cyclohexane from your skin. If your clothing becomes wet with cyclohexane, you must immediately remove the clothing and not wear it again until the cyclohexane has been removed.

Fire extinguishers where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where cyclohexane is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1038 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR CYCLOHEXANE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification.

1. Synonyms: Hexahydrobenzene; hexamethylene; and benzene hexahydride.

2. Formula: C6H12

3. Molecular weight: 84.2

B. Physical Data.

1. Boiling point (760 mm Hg): 80 C (177 F)

2. Specific gravity (water=1): 0.78

3. Vapor density (air=1): 2.98

4. Melting point: 6.5 C (44 F)

5. Vapor pressure at 20 C (68 F): 95 mm Hg

6. Solubility in water, % by weight at 20 C (68 F): Less than 0.01

7. Evaporation rate (butyl acetate=1): Data not available

8. Appearance and odor: Colorless liquid with a mild, sweet odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: −20 C (−4 F) (closed cup)

2. Autoignition temperature: 245 C (473 F)

3. Flammable limits in air, % by volume: Lower 1.3 Upper 8.4

4. Extinguishing media: Dry chemical, foam, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Cyclohexane is a flammable liquid. Its vapors can easily form explosive mixtures in air. All ignition sources must be controlled when cyclohexane is used, handled, and stored in a manner that could create a fire or explosion hazard. Cyclohexane vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the cyclohexane is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, cyclohexane is classified as a Class IB flammable liquid. For example, 3300 ppm, 25 percent of the lower flammable limit, is one situation in which cyclohexane is considered to be a fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for cyclohexane shall be Class I, Group D.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosion.

3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving cyclohexane.

4. Special precautions: None

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If cyclohexane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or a similar material and disposed of in a sanitary landfill. Cyclohexane may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods: Cyclohexane may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The methods of measurement must determine the concentration of cyclohexane to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of cyclohexane to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to cyclohexane can occur when transferring the liquid from one container to another.

B. Nonsparking tools must be used to open and close metal cyclohexane containers which must then be effectively grounded and bonded prior to pouring.

C. Store cyclohexane in tightly closed containers in a cool well-ventilated area away from ignition sources and strong oxidizing agents.

D. Employers must advise employees of all areas and operations where exposure to cyclohexane could occur.

E. Cyclohexane usually contains benzene as a impurity. Cyclohexane containing more than 0.1 weight percent benzene is highly toxic and the substance should be handled like benzene.

VI. COMMON OPERATIONS

Some common operations in which exposure to cyclohexane is likely to occur are where it is made by the hydrogenation of benzene, where it is a starting material for the synthesis of nylon, and where it is used as a solvent for fats, oils, waxes, and essential oils as in the perfume industry.

NOTE.—The information contained in Appendix C to § 1910.1038 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR CYCLOHEXANE

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

The main toxic effect of exposure to cyclohexane is irritation of the eyes, and mucous membranes of the upper respiratory tract. At high concentrations it may cause central nervous system depression. Aspiration may cause a chemical pneumonitis.

III. SIGNS AND SYMPTOMS

Irritation of eyes and mucous membranes of upper respiratory tract; headache; narcosis leading to coma may occur at sustained high levels. Excessive skin contact may produce a dermatitis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Most reported effects of cyclohexane are caused by its irritant properties. No bone marrow effects have been reported as in benzene. It is important that the physician become familiar with the operating conditions in which exposure to cyclohexane occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement.

Routine medical histories and physical examinations are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from cyclohexane exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease: Although cyclohexane is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Liver disease: Although cyclohexane is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

3. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of cyclohexane might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

4. Skin disease: Cyclohexane is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of cyclohexane.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, New York, 1965, pp. 130–133.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II. Toxicology, (2nd Ed. Revised), Interscience Publishers, New York, 1962, pp. 1208–1211.

3. Hygienic Guide Series, "Cyclohexane", American Industrial Hygiene Assoc., Detroit, Michigan, September–October 1963.

## § 1910.1039 Camphor.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of camphor, not in excess of 2 parts per million (ppm) (12 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z–1.

(2) "Action level" means one half of the permissible exposure for camphor.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which camphor is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of camphor at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of camphor.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to camphor;

(ii) Any measurements of camphor taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to camphor; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to camphor at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to camphor at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to camphor at or above the action level, but not above the permissible exposure, the exposure of that employee

shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to camphor above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to camphor above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to camphor below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| *Concentration* | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to camphor above the permissible exposure as defined in paragraph (a) (1) of this section.

(2) Employee exposures to airborne concentrations of camphor shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d) (4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of camphor.

(ii) Where a fan is located in ductwork and where camphor is present in concentrations greater than 1500 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of camphor to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Camphor*

| *Condition or concentration of dust or vapor* | *Respiratory protection* |
|---|---|
| 600 mg/m3 or 100 p/m, or less | Chemical cartridge respirator with organic vapor cartridge(s) and high efficiency particulate filter(s) with full facepiece.<br>Gas mask with a chin-style or front- or back-mounted organic vapor canister with high efficiency particulate filter.<br>Supplied-air respirator with a full facepiece, helmet, or hood.<br>Self-contained breathing apparatus with a full facepiece. |
| 1,200 mg/m3 or 200 p/m, or less | Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, hood, or helmet operated in continuous-flow mode. |
| Greater than 1,200 mg/m3 or 200 p/m, or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.<br>A combination respirator which includes a type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or continuous-flow mode and an auxiliary self-contained air supply operated in pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors and particulates.<br>Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for camphor.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of camphor shall be Class II, Group G.

(3) For the purpose of compliance with § 1910.157, camphor is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of camphor shall be Class II, Group G.

(5) Camphor shall be stored so as not to come in contact with oxidizing agents.

(6) Sources of ignition such as smoking or open flames are prohibited where camphor presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with solid camphor or liquids containing camphor. Face shields shall comply with § 1910.133 (a) (2), (a) (4), (a) (5), and (a) (6).

(2) Employers shall ensure that clothing contaminated with solid camphor or liquids containing camphor is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of camphor from

the clothing. If the clothing is to be laundered or otherwise cleaned to remove the camphor, the employer shall inform the person performing the operation of the hazardous properties of camphor.

(3) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a)(2)–(a)(6) where solid camphor or liquids containing camphor may contact the eyes.

(4) Employers shall ensure that nonimpervious clothing contaminated with camphor be removed promptly and not reworn until the camphor is removed from the clothing.

(g) *Spills and disposal.* In the event that camphor is spilled the employer shall immediately provide available ventilation, and then clean up the spill.

(h) *Sanitation.* (1) Employers shall ensure that employees whose skin becomes contaminated with solid camphor or liquids containing camphor promptly wash or shower with soap or mild detergent to remove any camphor from the skin.

(2) Employers shall ensure that employees do not eat or smoke in areas where camphor is handled, processed, or stored.

(3) Employers shall ensure that employees who handle camphor wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

(i) *Training and information.* (1) Each employer who has a workplace in which camphor is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to camphor above the action level or employees who have skin contact with solid camphor or liquids containing camphor or employees who work where camphor presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Camphor (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to camphor;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to camphor which are listed in Appendix A of this section:

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to camphor.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to camphor or airborne concentrations of camphor at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Convulsive seizures;

(ii) Eye disease;

(iii) Kidney disease;

(iv) Liver disease;

(v) Chronic respiratory disease;

(vi) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to camphor which are listed in Appendix A which the employee suspects are caused by exposure to camphor.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B, and C for camphor.

(ii) A description of the affected employee's duties as they relate to his exposure to camphor;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to camphor or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to camphor, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The pysician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to camphor.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to camphor or airborne concentrations of camphor in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to camphor.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to camphor.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to camphor which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j) (2) of this section;

(B) Any employee medical complaints relative to exposure to camphor;

(C) A copy of information provided to the physician pursuant to paragraphs (j) (4) (ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to camphor which is conducted pursuant to this section.

(2) When the observation of measurement of employee exposure to camphor requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne camphor that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1039 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR CAMPHOR

I. SUBSTANCE IDENTIFICATION

A. Substance: Camphor.

B. Permissible Exposure: 2 parts of camphor per million parts of air (ppm) (12 milligrams of camphor per cubic meter of air (mg/cu m)), averaged over an eight-hour work shift.

C. Appearance and Odor: White, transparent, crystalline masses with a characteristic odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Camphor can affect your body if it is inhaled, swallowed or if it comes in contact with your eyes, nose, throat, or skin.

B. Effects of Exposure:

1. Short-Term Exposure: Camphor may cause eye irritation, sore throat, nausea, vomiting, headache, and dizziness. It may also cause confusion, excitement, irrational behavior and convulsions. You may have a fever, bluish lips, pale face, and become unconscious. It may also affect your kidneys.

2. Long-Term Exposure: Repeated exposure to camphor may cause a loss of the sense of smell.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by camphor exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If camphor dust or solution gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If camphor dust or solution gets on your skin promptly wash the contaminated skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of camphor move the exposed person to fresh air at once. If breathing has stopped, perform artifical respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When camphor dust or solution has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the affected person to vomit by having him touch the back of his throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Never try to make an unconscious person vomit.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to camphor. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell camphor while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with with camphor dust or solution.

C. Eye Protection: You must wear splash-proof safety goggles where eye contact to camphor dust or solution may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

Camphor is a combustible solid and must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources, or oxidizing agents, especially chromic anhydride. Sources of ignition such as smoking and open flames are prohibited wherever camphor is handled, used, or stored in a manner that could create a fire or explosion hazard. If your clothing becomes contaminated with camphor, you must promptly remove the clothing and not wear it again until the camphor has been removed. If your skin becomes contaminated with camphor, you must promptly wash or shower using soap or mild detergent. Fire extinguishers, where provided, must be readily available and you should know how to operate them. Ask your supervisor where camphor is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1039 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR CAMPHOR

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification.

1. Synonyms: 1,7,7-Trimethyl-2-oxobicyclo-(2,2,4)heptane; 2-camphonone; synthetic camphor; gum camphor; and laurel camphor.

2. Formula: C10H16O.

3. Molecular weight: 152.2.

B. Physical Data.

1. Boiling point (760 mm Hg): 207.4 C (405 F).

2. Specific gravity (water=1): 1.00.

3. Vapor density (air=1): 5.3.

4. Melting point: 180 C (356 F).

5. Vapor pressure at 20 C (68 F): 0.18 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): 0.12.

7. Evaporation rate (butyl acetate=1): Less than 1.

8. Appearance and odor: White, transparent, crystalline masses with a characteristic odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 66 C (150 F) (closed cup).

2. Autoignition temperature: 466 C (871F).

3. Flammable limits in air, % by volume: Lower 0.6; Upper 3.5.

4. Extinguishing media: Dry chemical, foam, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Camphor is a combustible solid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when camphor is used, handled, and stored in a manner that could create a fire or explosion hazard.

7. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for camphor shall be Class II, Group G.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with oxidizing agents, especially chromic anhydride, may form explosive mixtures.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving camphor.

4. Special Precautions: None.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If camphor is spilled or leaked, collect material into container for subsequent recovery and re-use.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

Camphor may be disposed of:

1. If small quantities, by burning.

2. If large quantities, by recovering by sublimation.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The methods of measurement must determine the concentration of camphor to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of camphor to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. Store in a cool, well-ventilated area in tightly closed container away from ignition sources and oxidizing agents.

B. Employers must advise employees of all areas and operations where exposure to camphor could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to camphor is likely to occur are where camphor is used as a plasticizer in the manufacture of plastics, as preservative in pharmaceuticals and cosmetics, and as insect repellants (particularly clothes moths). Camphor is also used in lacquers and varnishes, in explosives, in pyrotechnics, in embalming fluids, in some foods and tobacco products, and in manufacturing cumene.

NOTE.—The information contained in Appendix C to § 1910.1039 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR CAMPHOR

I. ROUTE OF ENTRY

Inhalation; slow skin absorption.

II. TOXICOLOGY

Camphor is mainly a local irritant. Exposure to camphor may produce irritation of the eyes and nose, with a risk of loss of sense of smell. Very large exposures affect the central nervous system, resulting in nausea, vomiting, dizziness, agitation, and convulsions. Camphor may be either oxidized to carbonyl derivatives or conjugated with glucuronic acid. Most of the absorbed camphor and its metabolites are excreted by the kidneys. Complete recovery from overexposure is usually within 48 hours.

III. SIGNS AND SYMPTOMS

Irritation of eyes, skin, and mucous membranes of respiratory tract. At sustained high levels, nausea, vomiting, diarrhea, headache, dizziness, excitement, irrational behavior, epileptiform convulsions and coma.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Most information on the toxicity of camphor is from accidental ingestion by children. It is important that the physician become familiar with operating conditions in which exposure to camphor occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement.

Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from camphor exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Convulsive seizures: Camphor is a central nervous system stimulant. Those with pre-existing convulsive disorders may be at increased risk from exposure.

2. Eye disease: Camphor is reported to be a mild eye irritant. Those with chronic eye disease may be at increased risk.

3. Skin disease: Camphor is rubefacient. Persons with pre-existing skin disorders may be more susceptible to the effects of camphor.

4. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of camphor might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

5. Renal disease: The importance of this organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function. Renal involvement has been described in those with camphor poisoning.

6. Liver disease: Although camphor is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. Grant, W. Morton: Toxicology of the Eye (2nd Edition), Charles C. Thomas, Illinois, 1974, page 226.

2. Gronka, Paul A., et al.: "Camphor Exposures in a Packaging Plant," American Industrial Hygiene Association Journal, *30*, 276–279 (May–June 1969).

3. Ginn, H. Earl, et al.: "Camphor Intoxication Treated by Lipid Dialysis," Journal of American Medical Association, *203(3)*, 164–165 (1968).

## § 1910.1040 Mesityl oxide.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of mesityl oxide, not in excess of 25 parts per million (ppm) (100 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z–1.

(2) "Action level" means one half of the permissible exposure for mesityl oxide.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which mesityl oxide is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of mesityl oxide at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of mesityl oxide.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to mesityl oxide;

(ii) Any measurements of mesityl oxide taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to mesityl oxide; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to mesityl oxide at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to mesityl oxide as or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to mesityl oxide at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to mesityl oxide above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to mesityl oxide above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to mesityl oxide below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long-term or short-term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B(IV) of this section).

(2) The method of assessment shall have an accuracy, to a confidence level of 95 percent, or not less than that given in Table 1.

TABLE 1

| Concentration | Required accuracy (percent) |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to mesityl oxide above the permissible exposure as defined in paragraph (a) (1) of this section.

(2) Employee exposures to airborne concentrations of mesityl oxide shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d) (4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of mesityl oxide.

(ii) In the design of open-surface tank ventilation for the purposes of § 1910.94 (d), operations involving mesityl oxide shall be classified as B-2 at 21 C (70 F).

(iii) Where a fan is located in ductwork and where mesityl oxide is present in the ductwork in concentrations greater than 3200 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of mesityl oxide to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Mesityl Oxide*

| Condition or vapor concentration | Respiratory protection |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge(s). |
| | Gas mask with chin-style or front- or back-mounted organic vapor canister. |
| | Supplied-air respirator with a full facepiece, hood or helmet. |
| | Self-contained breathing apparatus with a full facepiece. |
| 5,000 p/m or less | Type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode. |
| Greater than 5,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| | A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors. |
| | Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for mesityl oxide.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of mesityl oxide shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, mesityl oxide is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence

of mesityl oxide shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid mesityl oxide is classified as a Class IC flammable liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance §§ 1910.108 and 1910.94(d).

(8) Sources of ignition such as smoking or open flames are prohibited where mesityl oxide presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid mesityl oxide. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with mesityl oxide be removed promptly and not reworn until the mesityl oxide is removed from the clothing.

(3) Employers shall ensure that clothing wet with mesityl oxide is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of mesityl oxide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the mesityl oxide, the employer shall inform the person performing the operation of the hazardous properties of mesityl oxide.

(4) Employers shall ensure that clothing which becomes wet with liquid mesityl oxide be removed immediately and not reworn until the mesityl oxide is removed from the clothing.

(5) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133 (a)(2)–(a)(6) where liquid mesityl oxide may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid mesityl oxide is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid mesityl oxide shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with mesityl oxide promptly wash or shower with soap or mild detergent to remove any mesityl oxide from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which mesityl oxide is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to mesityl oxide above the action level or employees who have skin contact with liquid mesityl oxide or employees who work where mesityl oxide presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Mesityl Oxide (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to mesityl oxide;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to mesityl oxide which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to mesityl oxide.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid mesityl oxide or airborne concentrations of mesityl oxide at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;
(ii) Liver disease;
(iii) Chronic respiratory disease;
(iv) Skin disease;
(v) Eye disease;
(vi) Central nervous system disorders.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section or any of the signs or symptoms of exposure to mesityl oxide which are listed in Appendix A which the employee suspects are caused by exposure to mesityl oxide.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B, and C for mesityl oxide;

(ii) A description of the affected employee's duties as they relate to his exposure to mesityl oxide;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to mesityl oxide or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to mesityl oxide, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to mesityl oxide.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid mesityl oxide or airborne concentrations of mesityl oxide in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to mesityl oxide.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to mesityl oxide.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to mesityl oxide which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d) (3) (i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to mesityl oxide;

(C) A copy of information provided to the physician pursuant to paragraph (j) (4) (ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to mesityl oxide which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to mesityl oxide requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne mesityl oxide that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1040 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR MESITYL OXIDE

I. SUBSTANCE IDENTIFICATION

A. Substance: Mesityl oxide.

B. Permissible Exposure: 25 parts of mesityl oxide per million parts of air (ppm) (100 milligrams of mesityl oxide per cubic meter of air (mg/cu m)), averaged over an eight-hour work shift (time weighted average).

C. Appearance and Odor: An oily colorless or clear pale yellow liquid with a strong peppermint-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Mesityl oxide can affect your body if it is inhaled, swallowed, or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-term Exposure: Mesityl oxide may cause irritation of the eyes, nose, and throat. Dizziness and headaches may also occur. The exposed person may have an unpleasant taste in the mouth after exposure. At high concentrations the vapor may cause unconsciousness in a short time. High concentrations may also cause damage to the liver, kidneys, and lungs.

2. Long-Term Exposure: Prolonged or repeated exposure of the skin to liquid mesityl oxide may cause irritation and inflammation of the skin.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by mesityl oxide exposure.

III. EMERGENCY FIRST AID PROCEDURE

A. Eye Exposure: If mesityl oxide gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If mesityl oxide gets on your skin promptly wash the contaminated skin using soap or mild detergent. If mesityl oxide soaks through your clothing, remove the clothing immediately and wash the skin using soap or a mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of mesityl oxide move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When mesityl oxide has been swallowed get medical attention immediately. If medical attention is not immediately available, get the affected person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Never try to make an unconscious person vomit.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to mesityl oxide. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell mesityl oxide while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid mesityl oxide.

C. Eye Protection: You must wear splash-proof safety goggles where eye contact with liquid mesityl oxide may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND HYGIENE

Mesityl oxide is a flammable liquid and its vapors can easily form explosive mixtures in air. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever mesityl oxide is handled, used, or stored in a manner that could create a fire or explosion hazard. You must use nonsparking tools when opening or closing metal containers of mesityl oxide, and containers must be bonded and grounded when pouring or transferring liquid mesityl oxide. If your skin becomes contaminated with mesityl oxide you must promptly wash or shower with soap or mild detergent. If your clothing becomes wet with liquid mesityl oxide, you must immediately remove the clothing and not wear it again until the mesityl oxide has been removed. Fire extinguishers, where provided, must be readily available and you

should know where they are and how to operate them. Ask your supervisor where mesityl oxide is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1040 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR MESITYL OXIDE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification.

1. Synonyms: 4-methyl-3-penten-2-one; isobutenyl methyl ketone; methyl isobutenyl ketone; and isopropylidene acetone.

2. Formula: $CH_3COCH=C(CH_3)_2$.

3. Molecular weight: 98.15.

B. Physical Data.

1. Boiling point (760 mm Hg): 130 C (266 F).

2. Specific gravity (water=1): 0.856.

3. Vapor density (air=1): 3.4.

4. Melting point: −46 C (−50.8 F).

5. Vapor pressure at 20 C (68 F): 8 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): 3.

7. Evaporation rate (butyl acetate=1): 0.55.

8. Appearance and odor: An oily colorless or clear pale yellow liquid with a strong peppermint-like odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 30.6 C (87 F) (closed cup).

2. Autoignition temperature: 344 C (652 F).

3. Flammable limits in air, % by volume: Lower: 1.3 at 37.8 C (100 F); Upper: 8.8 at 65.6 C (150 F).

4. Extinguishing media: Alcohol foam, dry chemical, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Mesityl oxide is a flammable liquid. Its vapors can easily form explosive mixtures in air. All ignition sources must be controlled when mesityl oxide is used, handled, and stored in a manner that could create a fire or explosion hazard. Mesityl oxide vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the mesityl oxide is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, mesityl oxide is classified as a Class IC flammable liquid. For example, 3200 ppm, 25 percent of the lower flammable limit, is one situation in which mesityl oxide is considered to be a fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for mesityl oxide shall be Class I, Group D.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with oxidizing agents may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving mesityl oxide.

4. Special Precautions: Mesityl oxide will attack and dissolve some forms of plastics, resins, and rubbers.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If mesityl oxide is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or similar material and disposed of in a sanitary landfill. Mesityl oxide may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

Mesityl oxide may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth, or similar material and disposing in a sanitary landfill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of mesityl oxide to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of mesityl oxide to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to mesityl oxide can occur when transferring the liquid from one container to another.

B. Non-sparking tools must be used to open and close metal mesityl oxide containers which must then be effectively grounded and bonded prior to pouring.

C. Store mesityl oxide in tightly closed containers in a cool well-ventilated area away from ignition sources and oxiding agents.

D. Employers must advise employees of all areas and operations where exposure to mesityl oxide could occur.

VI. COMMON OPERATIONS

Mesityl oxide is used as a solvent for: lacquers; cellulose materials; vinyl chloride; high molecular weight copolymer resins; stains; and roll-coating inks. It is also used in the leather industries and as an organic intermediate for methyl isobutyl carbinal. It also has found utility in ore flotation.

NOTE.—The information contained in Appendix C to § 1910.1040 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C

MEDICAL SURVEILLANCE GUIDELINES FOR MESITYL OXIDE

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

There is some local irritation of tissues by solvent effect of mesityl oxide on lipids. Central nervous system depression may occur on exposure to high concentrations, producing narcosis. Liquid mesityl oxide may cause marked irritation and corneal injury when in contact with the eye. Effects may be more pronounced in unacclimated individuals. Mesityl oxide may be oxidized to acetone, ketones, or keto-acids which are excreted by the kidney or the lung. Chronic effects on the central nervous system have been reported in animals, as well as kidney damage at high exposures.

III. SIGNS AND SYMPTOMS

Irritation of eyes and mucous membranes of upper respiratory tract; narcosis leading to coma at sustained high levels. Central nervous effects (spasticity) develop in animals after repeated exposure, but no reported case in humans.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Most reported effects of mesityl oxide are caused by its irritant properties. Chronic systemic effects have been reported in animals and should be considered in surveillance of workers. The possibility of significant skin absorption should also be considered. It is important that the physician become familiar with operating conditions in which exposure to mesityl oxide occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement.

Routine medical histories and physical examinations are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from mesityl oxide exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease: Although mesityl oxide is not known as a kidney toxin in humans, kidney damage has been reported in experimental animals. The importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of mesityl oxide might cause exacerbation of symptoms due to irritant properties or psychic reflex bronchospasm.

3. Liver disease: Although mesityl oxide is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

4. Skin disease: Mesityl oxide is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of mesityl oxide.

5. Eye disease: Mesityl oxide is reported to be an eye irritant. Those with chronic eye disease may be at increased risk from mesityl oxide exposure.

6. Central nervous system disorders: Exposure to high concentrations of mesityl oxide vapor may cause damage to the central nervous system, to which individuals with pre-existing conditions may be more susceptible.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. Grant, W. Morton: Toxicology of the Eye (2nd Edition), Charles C. Thomas, Illinois, 1974, page 337.

2. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, New York, 1965, pp. 440–442.

3. Patty, Frank A.: Industrial Hygiene and Toxicology, Volume II Toxicology (2nd Ed. Revised), Interscience Publishers, New York, 1963, pp. 1756–1758.

## § 1910.1041 5-Methyl-3-heptanone.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of 5-methyl-3-heptanone, not in excess of 25 parts per million (ppm) (130 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average) as stated in § 1910.1000, Table Z–1.

(2) "Action level" means one half of the permissible exposure for 5-methyl-3-heptanone.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which 5-methyl-3-heptanone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of 5-methyl-3-heptanone at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of 5-methyl-3-heptanone.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to 5-methyl-3-heptanone;

(ii) Any measurements of 5-methyl-3-heptanone taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to 5-methyl-3-heptanone; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to 5-methyl-3-heptanone at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to 5-methyl-3-heptanone at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to 5-methyl-3-heptanone at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to 5-methyl-3-heptanone above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to 5-methyl-3-heptanone above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to 5-methyl-3-heptanone below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration | Required accuracy (percent) |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to 5-methyl-3-heptanone above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of 5-methyl-3-heptanone shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne consentrations of 5-methyl-3-heptanone.

(ii) Where a fan is located in ductwork and where 5-methyl-3-heptanone is present in the ductwork in concentrations greater than 3500 ppm the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of 5-methyl-3-heptanone to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for 5-Methyl-3-heptanone*

| *Condition or vapor concentration* | *Respiratory protection* |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge(s).<br>Gas mask with chin-style or front- or back-mounted organic vapor canister.<br>Supplied-air respirator with a full facepiece, hood, or helmet.<br>Self-contained breathing apparatus with a full facepiece. |
| 3,000 p/m or less | A type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode. |
| Greater than 3,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode.<br>A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors.<br>Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for 5-methyl-3-heptanone.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of 5-methyl-3-heptanone shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, 5-methyl-3-heptanone is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of 5-methyl-3-heptanone shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid 5-methyl-3-heptanone is classified as a Class II combustible liquid.

(6) Sources of ignition such as smoking or open flames are prohibited where 5-methyl-3-heptanone presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 5-methyl-3-heptanone. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with liquid 5-methyl-3-heptanone be removed promptly and not reworn until the 5-methyl-3-heptanone is removed from the clothing.

(3) Employers shall ensure that clothing wet with 5-methyl-3-heptanone is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of 5-methyl-3-heptanone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 5-methyl-3-heptanone, the employer shall inform the person performing the operation of the hazardous properties of 5-methyl-3-heptanone.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a)(2)–(a)(6) where liquid 5-methyl-3-heptanone may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid 5-methyl-3-heptanone is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid 5-methyl-3-heptanone shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with 5-methyl-3-heptanone promptly wash or shower with soap or mild detergent to remove any 5-methyl-3-heptanone from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which 5-methyl-3-heptanone is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to 5-methyl-3-heptanone above the action level or employees who have skin contact with liquid 5-methyl-3-heptanone or employees who work where 5-methyl-3-heptanone presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for 5-Methyl-3-heptanone (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to 5-methyl-3-heptanone;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to 5-methyl-3-heptanone which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to 5-methyl-3-heptanone.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid 5-methyl-3-heptanone or airborne concentrations of 5-methyl-3-heptanone at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to 5-methyl-3-heptanone which are listed in Appendix A which the employee suspects are caused by exposure to 5-methyl-3-heptanone.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B, and C for 5-methyl-3-heptanone;

(ii) A description of the affected employee's duties as they relate to his exposure to 5-methyl-3-heptanone;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this

section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6) (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to 5-methyl-3-heptanone or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to 5-methyl-3-heptanone, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to 5-methyl-3-heptanone.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid 5-methyl-3-heptanone or airborne concentrations of 5-methyl-3-heptanone in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to 5-methyl-3-heptanone.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to 5-methyl-3-heptanone.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to 5-methyl-3-heptanone which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to 5-methyl-3-heptanone;

(C) A copy of information provided to the physician pursuant to paragraphs (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to 5-methyl-3-heptanone which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to 5-methyl-3-heptanone requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne 5-methyl-3-heptanone that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1041 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR 5-METHYL-3-HEPTANONE

I. SUBSTANCE IDENTIFICATION

A. Substance: 5-Methyl-3-heptanone.

B. Permissible Exposure: 25 parts of 5-methyl-3-heptanone per million parts of air (ppm) (130 milligrams of 5-methyl-3-heptanone per cubic meter of air (mg/cu m)) averaged over an eight-hour work shift (time weighted average).

C. Appearance and Odor: Colorless liquid with a mild fruity odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: 5-Methyl-3-heptanone can affect your body if it is inhaled, swallowed or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-Term Exposure: 5-Methyl-3-heptanone may irritate your eyes, nose and throat, and may cause headache, and dizziness. At high air concentrations the vapor may cause unconsciousness in a short time.

2. Long-Term Exposure: Prolonged or repeated skin contact may cause dryness and irritation of your skin.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by 5-methyl-3-heptanone exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If 5-methyl-3-heptanone gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If 5-methyl-3-heptanone gets on your skin promptly wash the contaminated skin using soap or mild detergent. If 5-methyl-3-heptanone soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of 5-methyl-3-heptanone move the exposed person to fresh air at once. If breathing has stopped, per-

form artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When 5-methyl-3-heptanone has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the affected person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Never try to make an unconscious person vomit.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to 5-methyl-3-heptanone. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell 5-methyl-3-heptanone while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid 5-methyl-3-heptanone.

C. Eye Protection: You must wear splash-proof safety goggles where eye contact to liquid 5-methyl-3-heptanone may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

5-Methyl-3-heptanone is a combustible liquid and its vapors can form explosive mixtures in air at elevated temperatures. It must be stored in tightly closed containers, in a cool well-ventilated area, away from strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever 5-methyl-3-heptanone is handled, used, or stored in a manner that could create a fire or explosion hazard. You must use nonsparking tools when opening or closing metal containers of 5-methyl-3-heptanone and the containers must be bonded and grounded when pouring or transferring the liquid. You must promptly remove any non-impervious clothing that becomes contaminated with liquid 5-methyl-3-heptanone and this clothing must not be reworn until the 5-methyl-3-heptanone has been removed from the clothing. If your skin becomes contaminated with 5-methyl-3-heptanone, you must promptly wash or shower using soap or mild detergent. Fire extinguishers, where provided, should be readily available and you should know where they are and how to use them. Ask your supervisor where 5-methyl-3-heptanone is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1041 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR 5-METHYL-3-HEPTANONE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification.

1. This substance has been inaccurately designated as ethyl sec-amyl ketone. The more precise name for this substance is 5-methyl-3-heptanone. It is also inaccurately referred to as ethyl amyl ketone, EAK, and amyl ethyl ketone.

2. Formula: $C_2H_5COCH_2CH(CH_3)CH_2CH_3$.

3. Molecular weight: 128.1.

B. Physical Data.

1. Boiling point (760 mm Hg): 159 C (318 F).

2. Specific gravity (water=1): 0.82.

3. Vapor density (air=1): 4.4.

4. Melting point: −57 C (−70 F).

5. Vapor pressure at 20 C (68 F): 2 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): 0.26.

7. Evaporation rate (butyl acetate=1): 0.26.

8. Appearance and odor: Colorless liquid with a mild fruity odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 43.3 C (110 F) (closed cup).

2. Autoignition temperature: Data not available.

3. Flammable limits in air, % by volume: Lower: Data not available.

4. Extinguishing media: Dry chemical, foam, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to keep containers exposed to a fire cool.

6. Unusual fire and explosion hazards: 5-Methyl-3-heptanone is a combustible liquid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when 5-methyl-3-heptanone is used, handled, and stored in a manner that could create a potential fire or explosion hazard. 5-Methyl-3-heptanone vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the 5-methyl-3-heptanone is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, 5-methyl-3-heptanone is classified as a Class II combustible liquid.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for 5-methyl-3-heptanone shall be Class I, Group D.

B. Reactivity.

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with oxidizing agents may cause fire and explosions.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving 5-methyl-3-heptanone.

4. Special Precautions: None

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If 5-methyl-3-heptanone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth, or a similar material and disposed of in a sanitary landfill. 5-Methyl-3-heptanone may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

5-Methyl-3-heptanone may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of 5-methyl-3-heptanone to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of 5-methyl-3-heptanone to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to 5-methyl-3-heptanone can occur when transferring the liquid from one container to another.

B. Nonsparking tools must be used to open and close metal 5-methyl-3-heptanone containers which must then be effectively grounded and bonded prior to pouring.

C. Store 5-methyl-3-heptanone in tightly closed containers in a cool well-ventilated area away from ignition sources and oxidizing agents.

D. Employers must advise employees of all areas and operations where exposure to 5-methyl-3-heptanone could occur.

VI. COMMON OPERATIONS

5-Methyl-3-heptanone may be found in surface coating and silk screen printing operations, in the rubber industry, and as a chemical intermediate.

NOTE.—The information contained in Appendix C to § 1910.1041 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR 5-METHYL-3-HEPTANONE

I. ROUTE OF ENTRY

Inhalation; insignificant skin absorption.

II. TOXICOLOGY

There is local irritation of tissues by solvent effect of 5-methyl-3-heptanone on lipids. Vapor causes irritation of eyes and mucous membranes of upper respiratory tract. Central nervous system depression may occur on exposure to high concentrations, producing narcosis. No chronic effects are reported in humans.

III. SIGNS AND SYMPTOMS

Intense irritation of eyes and mucous membranes of upper respiratory tract; headache; narcosis leading to coma may occur at sustained high levels of exposure. Excessive skin contact may produce a dermatitis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Most reported effects of 5-methyl-3-heptanone are caused by its irritant properties. It is important that the physician become familiar with operating conditions in which exposure to 5-methyl-3-heptanone occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement.

Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from 5-methyl-3-heptanone exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease: Although 5-methyl-3-heptanone is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Liver disease: Although 5-methyl-3-heptanone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

3. Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 5-methyl-3-heptanone might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

4. Skin disease: 5-methyl-3-heptanone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of 5-methyl-3-heptanone.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. Patty, Frank A.: Industrial Hygiene and Toxicology, Volume II, Toxicology (2nd Ed. Revised) Interscience Publishers, New York, 1962, pp. 1734–1735.

2. Thienes, Clinton H., and Thomas J. Haley: Clinical Toxicology (Fifth Edition), Lea and Febiger, Philadelphia, 1972, p. 137.

## § 1910.1042 Ozone.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of ozone, not in excess of 0.1 parts per million (ppm) (0.2 milligrams per cubic meter (mg/cu m)), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z–1.

(2) "Action level" means one half of the permissible exposure for ozone.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which ozone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of ozone at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of ozone.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to ozone;

(ii) Any measurements of ozone taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to ozone; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to ozone at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour work shift (time weighted average) exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to ozone at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to ozone at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to ozone above the permissible exposure, the employer shall:

(i) Measure monthly the exposure of the employee so exposed;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to ozone above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to ozone below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent of not less than that given in Table 1.

TABLE 1

| *Concentration* | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to ozone above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of ozone shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five

days of any change in production, process, or control which might result in an increase in airborne concentrations of ozone.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of ozone to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposures, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Ozone.*

| *Condition or gas concentration* | *Respiratory protection* |
|---|---|
| 1 p/m or less | Chemical cartridge respirator with organic vapor cartridge(s).<br>Supplied-air respirator.<br>Self-contained breathing apparatus. |
| 5 p/m or less | A chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).<br>Gas mask with a chin-style or front- or back-mounted organic vapor canister.<br>Supplied-air respirator with a full facepiece, helmet, or hood.<br>Self-contained breathing apparatus with a full facepiece. |
| 10 p/m or less | A type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode. |
| Greater than 10 p/m or entry or escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in pressure demand or other positive pressure mode.<br>A combination respirator which includes a type C supplied-air respirator with a full facepiece operated in pressure demand or other positive pressure mode or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand or other positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. |
| Escape | Any gas mask providing protection against organic vapors.<br>Any escape self-contained breathing apparatus. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e), and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for ozone.

(2) Sources of ignition such as smoking or open flames are prohibited where ozone presents a fire or explosion hazard.

(f) *Personal protective equipment.* (Reserved).

(g) *Spills and disposal.* (Reserved).

(h) *Sanitation.* (Reserved).

(i) *Training and information.* (1) Each employer who has a workplace in which ozone is present shall keep a copy of this regulation with Appendix A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to ozone above the action level or employees who work where ozone presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Ozone (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to ozone;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to ozone which are listed in Appendix A of this section; and

(iv) Provide training the ensure that affected employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to ozone.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) *Preplacement medical examination.* The employer shall make available to each employee who is exposed, or will be exposed, to airborne concentrations of ozone at or above the action level, without regard to the use of respirators, a preplacement medical examination which must include as a minimum the following:

(i) A medical history and physical examination with emphasis on heart and lungs;

(ii) 14" x 17" chest roentgenogram;

(iii) Forced vital capacity (FVC) and forced expiratory volume-one second (FEV (1 second)) tests.

(3) *Periodic medical examination.* The employer shall make available to each employee exposed to airborne concentrations of ozone at or above the action level, without regard to the use of respirators, twelve months from the date of the employee's first exposure, and every twelve months thereafter, a periodic medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the respiratory system;

(ii) Forced vital capacity (FVC) and forced expiratory volume-one second (FEV (1 second)) tests;

(iii) A 14" x 17" chest roentgenogram, if pulmonary function tests show significant abnormalities.

(4) *Alternative medical procedures.* If the examining physician chooses to use alternative medical procedures to those specified in paragraphs (j)(2) and (j)(3) of this section, the employer may accept such alternative medical procedures as meeting the requirements of this section provided that the employer:

(i) Obtains a statement from the examining physician setting forth the alternative medical procedures, the rationale for substitution, and evidence that they will be equally effective;

(ii) Informs each exposed worker of the fact that alternative medical procedures to those required in paragraphs (j)(2) and (j)(3) of this section are to be made available.

(5) *Interim medical examination.* The employer shall provide an interim medical examination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to ozone which are listed in Appendix A which the employee suspects are caused by exposure to ozone.

(6) *Informing the physician.* The employer shall provide to the physician performing any medical examination required by this section the following information:

(i) A copy of this regulation with Appendixes A, B, and C for ozone;

(ii) A description of the affected employee's duties as they relate to his exposure to ozone;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous

medical examinations of the affected employee.

(7) Where a medical examination is required by paragraphs (j) (2), (j) (3), or (j) (5) of this section, following such examination the employer shall obtain from the examining physician a written opinion which conforms with paragraph (j) (8) of this section.

(8) *Physician's written opinion.* (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to ozone or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to ozone, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to ozone.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(9) *Results of tests.* Where a preplacement or periodic medical examination is required by paragraphs (j) (2) or (j) (3) of this section, following such examination the employer shall obtain from the examining physician:

(i) A recording of the pulmonary function tests;

(ii) The 14" x 17" chest roentgenogram when required, or a medically acceptable copy;

(iii) Where alternative medical procedures have been performed in accordance with paragraph (j) (4) of this section, a recording of such alternative procedures.

(10) No employee shall be exposed to ozone in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(11) No medical procedure which would be performed pursuant to paragraphs (j) (2) or (j) (3) of this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(12) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(13) The employer shall provide emergency medical treatment for any employee injured through exposure to ozone.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b) (1) of this section.

(ii) The record shall include the written determination required in paragraph (b) (2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to ozone.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to ozone which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d) (3) (i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Any employee medical complaints relative to exposure to ozone;

(B) A copy of information provided to the physician pursuant to paragraphs (j) (6) (ii), (iv), (v), and (vi) of this section.

(C) Results of tests required by paragraphs (j) (2) and (j) (3) of this section and results of any tests conducted pursuant to paragraph (j) (4) of this section;

(D) Physician's written opinion; and

(E) A signed statment of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to ozone which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to ozone requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne ozone that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE.—The information contained in Appendix A to § 1910.1042 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET FOR OZONE

I. SUBSTANCE IDENTIFICATION

A. Substance: Ozone.

B. Permissible Exposure: 0.1 parts of ozone per million parts of air (ppm) (0.2 milligrams of ozone per cubic meter of air (mg/cu m)) average over an eight-hour work shift.

C. Appearance and Odor: Colorless to blue gas (depends on concentration) with a pungent, characteristic odor.

II. HEALTH HAZARD DATA

A. Comments: Ozone is a very toxic substance with good warning properties.

B. Ways in Which the Chemical Affects Your Body: Ozone can affect your body if it is inhaled or if it comes in contact with your eyes, nose, or throat.

C. Effects of Exposure:

1. Short-Term Effects. When you are exposed to very low concentrations of ozone for even brief periods of time, you may notice a sharp irritation odor. As the concentration of ozone increases, your ability to smell it may decrease. You may experience irritation of your eyes, dryness of your nose and throat, and cough. If the ozone concentration continues to rise, more severe symptoms may develop. These may include headache, upset stomach or vomiting, pain or tightness in your chest, shortness of breath or tiredness which may last for several days to weeks. Finally, with higher levels of exposure, your lungs may be damaged and death may occur.

2. Reporting Signs and Symptoms: You should inform your employer if you delevop any signs or symptoms and suspect that they are caused by ozone exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If ozone gets into your eyes, get medical assistance as soon as possible.

B. Breathing: If you or any other person breathes in large amounts of ozone remove the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep affected person warm and at rest. Get medical attention immediately.

C. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the rescue equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to ozone. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove indaquate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell ozone while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You do not need special protective clothing for exposure to ozone.

C. Eye Protection: The respiratory equipment that is supplied by your employer for exposures to high concentrations of ozone will protect your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

Avoid inhalation of ozone. Where ozone is generated for use in chemical processes, explosion hazards exist. Ask your supervisor where ozone may be present in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

NOTE.—The information contained in Appendix B to § 1910.1042 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX B—SUBSTANCE TECHNICAL GUIDELINES FOR OZONE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: None.

2. Formula: $O_3$.

3. Molecular weight: 48.

B. Physical Data.

1. Boiling point (760 mm Hg): −112 C (−169.6 F).

2. Specific gravity (water=1): Not applicable.

3. Vapor density (air=1): 1.65.

4. Melting point: −192 C (−313 F).

5. Vapor pressure at 20 C (68 F): Not applicable.

6. Solubility in water, % by weight at 20 C (68 F): 3 ppm.

7. Evaporation rate (butyl acetate=1): Not applicable.

8. Appearance and odor: Colorless to blue gas (depends on concentration) with a pungent, characteristic odor.

II. FIRE, EXPLOSION, AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: Not applicable.

2. Autoignition temperature: Not applicable.

3. Flammable limits in air, % by volume: Not applicable.

4. Extinguishing media: Use large amounts of water spray.

5. Special fire-fighting procedures: Since ozone is a form of oxygen, methods based on smothering are not suitable to put out fires involving ozone.

6. Unusual fire and explosion hazards: Ozone is a form of oxygen and will support combustion. It can contribute to the intensity of a fire but there are few, if any, situations where this is likely because of the very low concentrations that exist in practice.

B. Reactivity.

1. Conditions contributing to instability: Ozone spontaneously decomposes under all ordinary conditions so that it is not encountered except in the immediate vicinity of where it was formed. The decomposition is speeded by solid surfaces and by many chemical substances.

2. Incompatibilities: Ozone is a powerful oxidizing agent and reacts with all oxidizable materials both organic and inorganic, Some reaction products are highly explosive.

3. Hazardous Decomposition Products: None.

4. Special Precautions: None.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If ozone is spilled or leaked, the following steps should be taken:

1. Shut down generating source.

2. Ventilate area until odor is no longer detectable.

B. Persons not wearing an appropriate respirator should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods: Not applicable.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. Exposure Above the Action Level: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The methods of measurement must determine the concentration of ozone to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of ozone to plus or minus 25%.

C. Methods: Methods meeting these accuracy requirements are available from NIOSH.

D. Evaluation of Results: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers may wish that the evaluation of employee exposures be performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. Where ozone is generated for use in chemical synthesis, unusual explosion hazards exist.

B. Hazards associated with liquid ozone or with solutions of ozone in solvents require special treatment. Skin contact should be avoided. These situations are rarely encountered.

C. Employers must advise employees of all areas and operations where exposure to ozone could occur.

VI. COMMON OPERATIONS

Ozone is commonly used as an oxidizing agent in: the purification of drinking water; the preparation of chemicals; the treatment of industrial wastes; the deodorization of air and sewage gases; and the bacteria control on food in cold storage. Ozone may also be produced unintentionally by operations involving high intensity ultraviolet light (such as hot metal operations, plasma torch operations, direct copying machines, etc.) and high voltage electrical equipment (such as electrostatic precipitators, corona discharge, arc welding, etc.).

NOTE.—The information contained in Appendix C to § 1910.1042 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES FOR OZONE

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Ozone is extremely irritating to the upper and lower respiratory tract. The characteristic odor is readily detectable at low concentrations (0.01 ppm to 0.05 ppm). Ozone produces local irritation of the eyes and mucous membranes and may cause pulmonary edema at high exposure. Systemically, ozone has been reported to mimic the effects of ionizing radiation, and may cause damage to chromosomal structures. A partial tolerance appears to develop with repeated exposures. Although most effects are acute, the possibility of chronic lung impairment must be considered based upon animal experimentation. Ozone has reportedly produced an observed, or suspected carcinogenic response in animals based upon published articles in the literature.

III. SIGNS AND SYMPTOMS

Irritation of eyes and mucous membranes of upper respiratory tract. Pulmonary function tests may show abnormalities. High exposures may cause delayed pulmonary edema. The possibility of signs and symptoms of chronic respiratory disease should be considered in those chronically exposed.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. The use of corticosteroids in cases of lung damage has been reported.

Hospitalization should be considered because of the possible delayed pulmonary edema and hemorrhage in acute exposures.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. General.

Ozone exposure is potentially dangerous. The development of pulmonary edema is often delayed and those suspected of high exposures should be carefully observed. Because of reported radiomimetic effects the possibility of chromosomal damage must be considered. It is highly recommended that the physician become familiar with the conditions under which ozone is used and the preventive measures of importance in controlling exposures. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. Preplacement Examination.

The following medical examinations must be made available to each employee who is exposed to ozone.

1. A complete medical history and physical examination with emphasis on the heart and lungs. The purpose of the complete examination is to detect preexisting medical conditions which might place an employee at increased risk to reported effects of exposure and to establish a baseline for future monitoring. Examination of the heart and lungs should be stressed.

2. 14" x 17" chest roentgenogram; ozone may cause lung damage. Surveillance of the lungs is indicated.

3. FVC and FEV1. Ozone is reported to cause decreased pulmonary function. Periodic surveillance is indicated.

C. Periodic Examinations.

The above medical examinations are to be repeated on an annual basis except that an x-ray is required only when indicated by pulmonary function testing.

D. Interim Examinations.

If the employer is informed by the employee of the development of any signs or symptoms of exposure to ozone which the employee suspects are caused by such exposure, the employer must refer such employee for an interim examination.

VII. REFERENCES

1. Jaffe, L. S.: "The Biological Effects of Ozone on Man and Animals," American Industrial Hygiene Association Journal, *28*: 267–277 (May–June, 1967).

2. Stokinger, H. E.: "Ozone Toxicology." Archives of Environmental Health; *10*:719–731 (1965).

3. Hallette, Wilbur: "Effect of Ozone and Cigarette Smoke on Lung Function, "Archives of Environmental Health, *10*:295–306 (1965).

4. King, Maurice E.: "Toxicity of Ozone V. Factors Affecting Acute Toxicity" Medicine and Surgery, 39:93–94 (1963).

[FR Doc.75-26461 Filed 9-30-75;3:50 pm]